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WILLIAM CHESELDEN.

1688–1752.

William Cheselden was born on October 19, 1688, at Somerby, in Leicestershire, close to the great British encampment of Borrow Hill. The son of George Cheselden by his wife Deborah, daughter of Major William Hubbert, he came of a family of wealthy graziers. He appears to have received a good classical education, and after a short apprenticeship to Mr. Wilkes, a surgeon at Leicester, was received as a house pupil by William Cowper (1666–1709), the anatomist, and at the age of fifteen was bound apprentice on December 7, 1703, to James Ferne, surgeon and lithotomist to St. Thomas's Hospital. On December 5, 1710, he was admitted to the freedom and Livery of the Barber-Surgeons' Company, and on January 29 following he was granted 'the great diploma,' a higher qualification which showed that he intended to practise pure surgery. He immediately began to teach anatomy by a course of thirty-five lectures, which were repeated four times a year, and in 1711 he was elected a Fellow of the Royal Society. The popularity of the lectures was so great that they interfered with the routine courses delivered at the Barber-Surgeons' Hall, and the following minute in regard to them is still extant. It runs:—

"At a Court of Assistants of the Company of Barbers and Surgeons held on March 25, 1714; our Master acquainting the Court that Mr. William Cheselden, a member of this Company, did frequently procure the dead bodies of malefactors from the place of execution and dissect the same at his own house, as well during the Company's Public Lecture, as at other times, without the leave of the Governors and contrary to the Company's bylaw in that behalf; by which it became more difficult for the beadles to bring away the Company's bodies and likewise drew many members of this Company and others from the public dissections and lectures at the Hall. The said Mr. Cheselden was thereupon called in; but having submitted himself to the pleasure of the Court, with a promise never to dissect at the same time as the Company had their lecture at the Hall, nor without leave of the Governors for the time being, the said Mr. Cheselden was excused for what had passed, with a reproof for the same pronounced by the Master at the desire of the Court."

The lectures were accordingly continued, first at Cheselden's own house, and afterwards for twenty years at St. Thomas's Hospital. They inaugurated the system of voluntary private teaching—as opposed to the older formal and compulsory lectures—which proved so useful to the progress of surgery in the hands of William and John Hunter, culminating in the private schools of the nineteenth century.

Cheselden applied for the post of surgeon on two occasions before he was elected at St. Thomas's Hospital. He was appointed Assistant Surgeon

in 1718, succeeded William Dickenson as a principal surgeon in 1719, and retired from the hospital March 29, 1738. From 1723 to 1727 Cheselden was occupied in perfecting the operation of lateral lithotomy, which he brought to such perfection by his extraordinary skill that the operation was hardly modified until it was replaced by litholapaxy at the end of the last century. On one occasion, at least, he removed a stone in fifty-four seconds, and there is a pleasing story told of his kindliness and dexterity: having tied up a child for lithotomy, he promised sugar-plums if there was no movement, and, the operation over, the little fellow immediately claimed a fulfilment of the promise. In 1727, Cheselden was appointed surgeon to Queen Caroline, and ten years later he was chosen surgeon to the Chelsea Hospital. He was one of the earliest surgeons to take an interest in diseases of the eye, a department of practice which had hitherto been wholly abandoned to quacks, and he described a method of treating certain forms of blindness by the formation of an artificial pupil, and of congenital blindness by couching the lens. He was living in Queen's Square, Westminster, in 1735–6, when Alexander Pope was his patient and lay ill at his house. The poet conceived a lasting affection for him, and mentions him in his Epistle to Lord Bolingbroke:—

> Late as it is, I put myself to school,
> And feel some comfort not to be a fool.
> Weak though I am of limb and short of sight,
> Far from a lynx and not a giant quite;
> I'll do what Mead and Cheselden advise
> To help these limbs and to preserve these eyes.
> Not to go back is somewhat to advance,
> And men must walk at least before they dance.

In answer to an inquiry from Swift as to who Cheselden was, Pope says in a letter dated March 25, 1736: "It shows that the truest merit does not travel so far any way as on the wings of poetry. He is the most noted and deserving man in the whole profession of Chirurgery, and has saved the lives of thousands by his manner of cutting for stone." And again, a month before his death, writing to Mr. Allen, Pope says, "There is no end of my kind treatment from the faculty. They are in general the most amiable companions and the best friends as well as the most learned men I know."

Cheselden deserved his popularity, for he was not only a first-rate surgeon, but he was good at many things outside his profession. Jonathan Richardson, the painter, complimented him in verse and painted his portrait. He was intimate with Mead and with Sir Hans Sloane, and he attended the death-bed of Sir Isaac Newton. No mean artist, he published a magnificent *Osteographia, or Anatomy of the Bones.* He is said to have drawn the plans for Old Putney Bridge and the Surgeons' Hall in the Old Bailey, so that he was something of an architect. He was also a keen patron of athletic sports, more especially of boxing.

He was made surgeon to Queen Caroline in 1728, but he had lost favour at Court in 1731, and was not consulted when the Queen died of a strangulated umbilical hernia in 1733. At the foundation of St. George's Hospital in 1733 Cheselden was appointed surgeon and lithotomist, a post he held until 1738, when his place was taken by his nominee, David Middleton.

WILLIAM CHESELDEN

From the Painting by Jonathan Richardson in the Royal College of Surgeons, London.

At the Barber-Surgeons' Company he filled the usual offices, and was Junior Warden in 1744. In conjunction with John Ranby he was instrumental in procuring the separation of the Surgeons from the Barbers, which had long been imminent. The Surgeons' Company was formed in 1745, and in the following year Cheselden was chosen Master. In the latter part of 1751 he suffered from a paralytic seizure, but seemed to regain his former health until April 10, 1752, when, being at Bath, he partook too heartily of ale and hot buns. A physician who was summoned ordered an emetic, but his advice was not followed, and the great surgeon died the same day. He was interred on the north side of the burial ground of Chelsea Hospital, and his tomb, lately renovated by the pious care of Col. Ligertwood, R.A.M.C., can still be seen from the Royal Hospital Road. His will is brief and to the point : " Being in perfect health I write this with my own hand and declare it to be my last will and testament. I give to my daughter D. W. Cotes five hundred pounds and all the rest and residue of my estate of what kind soever to my wife and make her full and sole executrix, Administratrix and assign. Witness my hand and seal, William Cheselden (l.s.). 24th March 1749/50." He married Miss Deborah Knight, of London, who survived him until 1754. Their only daughter, Deborah Wilhelmina, married Dr. Charles Cotes, of Woodcote, Shropshire. She died without issue.

Cheselden bore for arms : Quarterly ; 1 and 4. Argent ; a chevron between three crosses moline gules (Cheselden). 2. Argent ; on a fesse indented sable, three bezants (Brough). 3. Or ; an eagle displayed azure, beaked and feet gules (Mongomery).

Cheselden did not write much, but what he wrote is well and clearly expressed, and shows him to have been a scientific surgeon. His published works are :

1. *The Anatomy of the Humane Body*, first published in 1713, the thirteenth edition appearing in 1792. The book is dedicated to Dr. Richard Mead. It is well illustrated with copper plates, and the first edition deals entirely with human anatomy. The later editions are rather applied anatomy, for the author treats of the value of anatomy in relation to the surgical cases of which he gives details, and he adds various facts about comparative anatomy. He thus takes a broad view of the subject, for he says that " in describing of the parts I have pretty much neglected the Minutiæ in Anatomy ; Nor have I been very particular about those things which cannot be understood without being seen, and being seen need little description ; but have endeavoured to be more explicit about those which are of greatest use in Philosophy, Physic and Surgery ; And I could wish the dividing and distinguishing of parts were usually done with more regard to these valuable ends."

2. *The Treatise on the High Operation for Stone* was published in 1723. It gives a short account of the history of lithotomy, points out the ease with which suprapubic operations on the bladder can be performed, and shows the anatomical reasons which had caused a useful method to fall into disuse. The book, like the treatise on anatomy, is dedicated to Dr. Richard Mead. The treatise itself consists of thirty-six pages only. Bound up with it is a *Treatise on the High Operation for Stone*, by Francis Rosset, and another on

the same subject by Hildanus, whilst there is an appendix of " two cases to shew that Wounds into the Abdomen are not exceeding dangerous though the Guts should appear or thrust out at the Wound." Cheselden, however, soon gave up suprapubic lithotomy, modifying the method employed by Frère Jacques (1651–1719) until it became virtually a new operation known to his successors as ' lateral lithotomy.' Dr. Frank Payne says that " he executed it with extraordinary skill and brilliancy, and with a degree of success which even with the aid of modern improvements has hardly been surpassed. This classical operation was first performed on March 27, 1727. It soon became famous throughout Europe, and distinguished surgeons from Paris among other places came over (either of their own accord or in commission from some learned body) to become acquainted with Cheselden's method."

3. He published, in 1733, *Osteographia, or Anatomy of the Bones*, and dedicated it to Queen Caroline. The work is a magnificent folio of plates, with somewhat scanty letterpress. Its merits are that Cheselden caused the bones of the skeleton to be drawn to scale, and accurately. He trained his engravers, Gerard Vandergucht and Shinevoet, to work with a camera lucida, and he was materially helped by John Belchier (1706–1785) and Samuel Sharp (1700–1778), his pupils. He was actually able to invest the dry bones with some degree of humour, as witness the skeleton cat attacked by the bony dog. What Cheselden did for the bones by his publication of *Osteographia*, William Hunter afterwards did for the gravid uterus, probably being stimulated thereto by the earlier work.

ILEUS DUPLEX
(INFLAMMATORY ENTEROCOLIC ILEUS).*

By W. SAMPSON HANDLEY, London.

On the four previous occasions when the Council of this College has honoured me by election as a Hunterian Professor, I have brought before you work which was the joint product of the laboratory and of the hospital ward. I believe that every surgeon who wishes to advance his subject ought, throughout his career, to spend a portion of his time in the laboratory, following in this respect the great example of Lister. But the segregation of pathology from practice has unfortunately tended to the exclusion of the clinician from the laboratory, and thus it comes about that he is more and more restricted to the field which Moynihan has described as the pathology of the living. On the present occasion I wish to bring before you some gleanings from that field.

Nature and Causes of Ileus Duplex.—Adynamic or paralytic ileus is a condition in which non-mechanical intestinal obstruction results from muscular paralysis of a length of the intestinal canal. Most surgeons recognize it, though some deny its existence. The best classification of its causes is given by Murphy[1] :—

1. Muscular paralysis from trauma or exposure.
2. Local traumatic peritonitis.
3. Local or general septic peritonitis.
4. Embolism of the mesenteric vessels.
5. Pylephlebitis.
6. Strangulation of pedicles by mass ligatures, with reflex intestinal paralysis.

Though adynamic ileus is well-recognized, it nevertheless remains a kind of limbo to which obscure cases may be relegated. The subject is surrounded by that indefinable haze, the result of imperfect knowledge, which to the despair of the student envelops certain chapters of surgery, such for instance as those dealing with shock or with osteo-arthritis. It can only be clarified by patient methods similar to those which have lately been applied to the group of insects known indiscriminately to Artemus Ward as "skeeters." My attempt to-day is to pin out and dissect one variety of adynamic ileus which has characters so definite that it needs a distinctive name. For reasons which will appear I propose to call it 'ileus duplex.'

In order to place you at once in possession of my point of view, and to enable you to weigh the evidence later to be adduced, I shall begin by giving a brief dogmatic description of this condition.

---

* A Hunterian Lecture delivered before the Royal College of Surgeons of England, on March 8, 1915.

Definition.—Ileus duplex is a condition in which, as the result of a pelvic peritonitis there is obstruction of the intestine at two points: (*a*) In the ileum, at a point about three feet above the ileocæcal valve; (*b*) In the sigmoid colon, at the junction of its iliac and pelvic portions. These are the points at which the ileum and colon respectively cross the brim of the true pelvis to enter the pelvic cavity.

The segments of paralyzed intestine are two in number: firstly, the portion of ileum contained in the pelvis, that is to say, about the lower three feet, excluding the last two inches; and secondly, the portion of the large bowel contained in the true pelvis, i.e., the lowest portion of the pelvic colon and the upper portion of the rectum.

On account of the special liability of the pelvic peritoneum to bacterial invasion, my subject is one of great importance. I deem it worthy of your attention for three main reasons: first, because the condition, though curable by appropriate treatment, in the early stage often passes unrecognized under the pseudonym of general peritonitis; secondly, because the duplex character of the obstruction, as indicated in my title, has not hitherto been appreciated; and thirdly, because, as might be expected, defects in the pathological conception of the condition have been reflected in imperfect treatment. And in this condition, delayed or defective treatment means certain death.

Etiology.—Ileus duplex may result from any one of the many causes of pelvic peritonitis. Restricting myself to those causes included within the scope of my own experience, it may result from :—

1. Appendicitis.
2. Ascending infection of the genital tract, gonorrhœal or septic.
3. Rupture of the bladder.
4. Carcinoma of the rectum.

To these causes may be added from the experience of my gynæcological colleagues, Messrs. Berkeley and Bonney[2] :—

5. Septic conditions of the pelvic genital organs (pyosalpinx, carcinoma of the cervix), or operations for their relief.

It is probable that this list is not exhaustive. For example, in cases where an inguinal or femoral cystocele has been included in the ligature during the radical cure of hernia, death from 'septic peritonitis' is a common sequel unless the accident is promptly recognized and treated. One surgeon has recorded three such fatal cases as within his personal knowledge. In a recent case of the kind in which I was called in twenty-four hours after the primary operation, and in which as a precaution I opened the abdominal cavity to drain the pelvis, there was urinary extravasation in the cellular tissue of the cavum Retzii and at the back of the bladder. The subserous tissues were evascular, and evidently on the point of sloughing. In such a case, failing the provision of drainage, it is inevitable that pelvic peritonitis must follow, and accordingly ileus duplex may be a factor in the fatal result. Thus it seems likely that further experience will extend the list of causes which I have considered.

Ileus Duplex in Military Surgery.—It is highly probable that in the past, cases of ileus duplex have occurred unnoticed in military surgery. The cases in which the condition is likely to occur are those in which there is a

septic bullet-wound, piercing the bladder, or otherwise involving the pelvic cavity, whether the intestine is perforated or not. The pelvic peritonitis thus set up might, it appears, very easily cause that paralysis of the ileum and pelvic colon which has been demonstrated in cases of pelvic appendicitis. In such cases the earliest signs of intestinal obstruction should be the signal for surgical intervention of the kind indicated in this lecture. I would therefore bespeak the earnest attention of military surgeons to the subject with which I am dealing. I venture to predict that before the end of the war, successfully treated cases of ileus duplex of traumatic origin will be placed on record.

Appendicitis the commonest Cause of Ileus Duplex.—Appendicitis is by far the most frequent cause of ileus duplex, and for obvious reasons the appendix is nearly always pelvic in position. A retrocæcal appendix may, however, give rise to it. The appendix, when sheltered behind the cæcum, does not cause a general peritonitis, but a trickle of pus may descend from it over the pelvic brim to infect the pelvic cavity. Inflammation of the normally-placed appendix is not among the causes of ileus duplex, for it will either give rise to a localized abscess, or will infect the general peritoneum and not particularly the pelvis. Accordingly, the signs of general peritonitis in such cases overwhelm those due to infection of the pelvic peritoneum.

The special liability of pelvic appendicitis to give rise to ileus duplex joins with the ambiguity of its earlier symptoms to make it perhaps the most dangerous form of the disease. I believe that its present mortality can be very appreciably lowered by a general recognition of the danger.

Morbid Anatomy of Ileus Duplex as observed during Life.—It frequently happens in cases of pelvic peritonitis that pus is found in the pelvis lying free among practically normal coils of ileum which, though congested, have not lost their lustre. The bowel may contain gas, its wall is not œdematous, it has evidently not lost its motor power. The peritonitis remains superficial, and the wall of the gut does not become inflamed. Drainage of the pelvis and the subsequent use of turpentine enemata suffice for the successful treatment of such cases, which form a large majority of cases of pelvic peritonitis.

In other cases, and these alone interest us to-day, the coils of the pelvic ileum, bathed in pus, show evidence of acute inflammation of the bowel wall. Their peritoneal surface is dull, intensely congested, and covered with pus and flakes of lymph. The bowel wall itself is swollen and œdematous. The affected coils are empty, passively contracted, and motionless, and between adjacent coils are sharp angular kinks, sometimes fixed by flakes of sticky lymph. My colleague, Victor Bonney, who gave what is perhaps the earliest detailed description of the condition of the ileum in these cases, noted that the bowel is flattened like a strap, and he found that it is impossible by manipulation to force the gas from the intestine above into the inflamed segment of ileum, an important observation directly showing the paralysis of the inflamed bowel.

The conditions described, which involve the lower two or three feet of the ileum, immersed in the pelvic basin of pus, extend to within about two

FIG. 68.—ILEUS DUPLEX ARISING FROM GANGRENOUS PELVIC APPENDICITIS.

The pelvis is occupied by a pool of pus bathing the inflamed pelvic ileum and pelvic colon. The last two inches of the ileum is normal. The supra-pelvic ileum is much distended, but is neither paralyzed nor inflamed. A fairly sharp line separates it from the inflamed portion of the ileum. There is no peritonitis above the pelvic brim.

inches of the ileocæcal valve. The terminal two inches of the small intestine, extending from the brim of the pelvis to the ileocæcal valve, is usually collapsed and normal.

This condition of the pelvic ileum may no doubt coexist with a hopeless general peritonitis involving the whole area of the peritoneum. But in the cases we are considering, the supra-pelvic abdomen, though often not shut off by any lymph barrier, affords no sufficient evidence of peritonitis, except to one obsessed by a preconceived idea. The pelvic ileum only is inflamed. Higher up, the ileum presents its normal shiny appearance, or is at most slightly congested. No pus is present amid its coils. A fairly sharp boundary line separates it from the inflamed pelvic ileum. If the case is an early one, distention is absent. Soon, however, the supra-pelvic ileum begins to be distended, owing to the block produced by paralysis of the pelvic ileum. It fills from below upwards, for I recollect one case in which the jejunum was still empty while the ileum was distended. But in what may be regarded as the typical stage of ileus duplex, the supra-pelvic small bowel, though quite uninflamed, is greatly distended owing to the obstruction lower down. That in this stage it is not paralyzed is shown by the results of treatment. It must be clearly recognized that distention of the supra-pelvic small bowel, even when accompanied by slight congestion, is not adequate evidence of general peritonitis. If, however, the case is allowed to run its course, paralysis of the distended intestine supervenes, bacterial penetration of its walls occurs, and a general peritonitis may be found at the necropsy.

We now turn to the condition of the large intestine. Usually at the time the operation is performed the large intestine shows no evidence of inflammation, perhaps because it is situated further from the inflamed appendix, and shielded from early infection by the ileal coils. Clinical evidence, however, shows conclusively that in the course of a few days the pelvic colon, though its involvement is later and less constant than that of the pelvic ileum, shares in the inflammation and paralysis which has already overtaken the small bowel. To this point I shall return later, for its recognition is essential to success in treatment.

The portion of the large bowel situated between the ileal obstruction and the obstruction in the pelvic colon usually contains some flatus, and is neither collapsed nor distended.

Pathological Anatomy.—In many cases after death the necropsy fails to reveal the real secret of the condition. What is found is a general peritonitis, with general paralytic distention of the intestinal tract, a misleading confirmation of the usual diagnosis made during life. At the time it was made this diagnosis was nevertheless incorrect. No series of necropsies can establish the morbid anatomy of ileus duplex. In it two processes, namely, a spreading peritonitis of pelvic origin, and an intestinal obstruction, are running a race. In the early stages seen by the surgeon the obstruction is well ahead, and there is no peritonitis above the pelvic brim; in the post-mortem room stage the peritonitis has had time to overtake it, and may be more or less generalized. Moreover, since obstruction ends in peritonitis and peritonitis in obstruction, it may pass the wit of man to say after death which was the primary and which the secondary cause thereof.

The recognition of ileus duplex is a product of operating-theatre pathology, not of dead-house pathology, and supplies one more example of the truth of Moynihan's belief that intra-vitam rather than post-mortem inspections are at the present day the key to further advances in knowledge.

Clinical Signs and Symptoms.—The signs and symptoms of ileus duplex are those of acute intestinal obstruction, superposed on those of the pelvic inflammation which has caused it. A detailed description is perhaps superfluous, but a few special points need emphasis.

Vomiting, though not invariably an early symptom, is almost a constant one. An initial vomit is the rule in appendicitis, but continued vomiting is very exceptional. It is a most useful danger signal. When repeated vomiting occurs, the possibility of ileus duplex must be promptly considered, and careful instructions must be given to the nurse to watch for and record the passage of flatus. The cessation of flatus, in spite of enema and the use of the rectal tube, establishes the diagnosis of intestinal obstruction, and if the subcutaneous injection of eserine fails, recourse must be had to operation. Owing to the late and slow onset of the large-intestine paralysis, enemata may at first succeed in relieving the paretic colon. If, subsequently, vomiting and other symptoms persist, this delusive success must be ignored, or surgical intervention will come too late.

In typical cases there is moderate general distention of the abdomen, but owing to the acute onset of the obstruction, no opportunity occurs for those intestinal gymnastics which produce visible coiling in obstructions of slower development. Visible peristalsis is absent. Abdominal rigidity is also absent, except possibly in the hypogastric region. Abdominal rigidity depends upon inflammation of the parietal peritoneum of the anterior abdominal wall, and in operable cases of ileus duplex this district of the peritoneum is not inflamed except at its hypogastric margin. Care must be taken not to mistake for true rigidity that tension of the abdominal wall which results from the intestinal inflation. Abdominal respiration is embarrassed by the general distention, but is still present.

In untreated cases, the later signs merge completely into those of general peritonitis.

Proof of the Duplex Character of the Obstruction.—Let me now attempt to justify the dogmatic statements I have made. Inflammatory obstruction of the lower ileum is a well-recognized condition, and this lecture will fail in its principal object unless I am able to prove that in most cases of the kind there is also an obstruction in the pelvic colon. To this point I must now direct your attention.

Failure of Treatment if directed solely to the Ileal Obstruction.—In cases of obstruction of the lower ileum I have found by experience that a lateral anastomosis between the ileum, some little way above the point of obstruction, and the cæcum or ascending colon is, on the whole, a very successful method of treatment, *except in ileus of inflammatory origin.*

The following table shows an extraordinary difference in the prognosis of obstruction of the lower ileum according as the obstruction is inflammatory or non-inflammatory. The contrast is even more striking than the table would indicate, for the fatal case of 'obstruction by band' recovered from the

operation, only to die of phthisis. The table indicates my experience up to about 1908.

Table I.—Cases of Acute Obstruction of the Lower Ileum treated by Ileo-Colic Lateral Anastomosis.

Cause of Obstruction	Cases	Deaths	Recoveries
Obstruction by the appendix acting as a band (appendix also removed)	5	0	5
Obstruction by bands	3	1	2
Inflammatory ileus secondary to pelvic inflammation	5	4	1

The extraordinary difference in the prognosis of non-inflammatory and inflammatory cases might be explained by assuming that death in the latter is due to general peritonitis and not to obstruction. But as we shall see, clinical observation does not bear out this view.

The contrast between my successful results in cases of obstruction by band, and my mortifying record of failure in inflammatory ileus, puzzled and depressed me. It seemed clear that in inflammatory ileus an unrecognized factor was at work; but I was unable to identify it, and the text-books did not assist me. The first ray of light on the problem came in 1910 from the following case, which I shall ask you to allow me to consider in full.

Case 8.—**Pelvic appendicitis. Ileus duplex. Ileo-sigmoidostomy. Recurrence of symptoms of obstruction. Cæcostomy. Recovery.**

At the request of Dr. Glanville, of Hampstead, I saw with him in 1910 an old lady of about 70, suffering with acute abdominal pain, rather more severe on the right side than on the left, but not definitely localized in the right iliac fossa. Chronic constipation had been a marked trouble. The temperature was slightly raised and the pulse somewhat quickened. These symptoms had been present for about twenty-four hours. There was no abdominal rigidity, nor could any tumour be felt in the right iliac fossa. There was in this region some tenderness on deep pressure. No tenderness was elicited on vaginal or rectal examination. On opening the abdomen in the middle line, within twenty-four hours of the onset of symptoms, I found a gangrenous appendix hanging down into the pelvis. It proved to be impossible to remove it without making a second incision in the right iliac fossa. The coils of the pelvic ileum were intensely congested, but there was no pus present, nor did there seem to be any indication that the congested ileum was paralyzed.

During the succeeding forty-eight hours, although the patient's pulse and general condition were fairly good, no flatus was passed, and the abdomen became much distended. It was obvious that there was complete inflammatory obstruction of the lower ileum, and that the patient would die unless something further was done. The median wound was opened up, and a lateral ileosigmoidostomy was performed as quickly as possible. Pus was found free in the pelvis, and a drainage tube was introduced to the bottom of the pouch of Douglas. Dr. Embleton, pathologist to the University College Hospital, was asked to examine the pus, and, on his advice, based on immediate microscopic examination, a large dose of anti-streptococcic serum and a stock vaccine of *Staphylococcus aureus* were administered shortly after the operation. Sixteen hours later no flatus had passed, and the patient's condition was extremely grave, indeed apparently hopeless. The pulse had become very rapid and feeble, and abdominal distention had increased. Small doses of calomel by the mouth caused sickness, and turpentine enemas

were ineffectual. Dr. Glanville urged that strong purgatives should be administered, and to this course I consented because I thought the case was hopeless. He carefully passed a stomach-tube, but it was repeatedly returned. Another anæsthetic was therefore given sixty hours after the first operation, so that the stomach could be washed out and placed in a condition to retain purgatives. Dr. Glanville then administered through the stomach-tube five grains of calomel, an ounce of magnesium sulphate, and a minim of croton oil. These heroic measures were followed the next morning by a copious evacuation, and the patient's condition then began to improve, although there was suppuration of the incisions owing to the virulence of the bacteria. An autogenous vaccine was prepared by Dr. Embleton, and administered, apparently with good results. A week later, however, abdominal distention recurred and became extreme, although flatus in small quantities continued to be passed. Partial obstruction evidently persisted, and paresis of the sigmoid below the ileosigmoidostomy was apparently the cause of it. I therefore opened the cæcum through the wound on the right side, without an anæsthetic, and tied in a catheter. The relief was immediate. From this time the patient slowly recovered strength, and she is now in excellent health, has been able to take a long railway journey, and is free from the chronic constipation which had troubled her for years before the operation. The cæcostomy closed spontaneously.

I have never seen a case recover in which death appeared so imminent and certain. The main part of the credit belongs to Dr. Glanville, who refused to despair when I had given up hope, though I may congratulate myself that my ileosigmoidostomy was able to stand the strain imposed upon it by his heroic and almost veterinary cathartics.

The successful result of this case clearly indicated to me the reason of my previous failures. In my early cases I had been dealing with one obstruction, and had ignored a second. My tentative and halting treatment of this case is obviously open to criticism in the light of my present knowledge. But it has this great value, that it affords an experimental dissection of ileus duplex into its three pathological elements—pelvic peritonitis, ileal obstruction, and colic obstruction. It is a crucial instance. In the first operation the peritonitis and its cause were treated. In spite of this the morbid picture continued to develop, and obstruction became manifest. The second operation short-circuited the small intestine obstruction. Its success was temporary only, and the purgatives which followed it produced only a transient result. The third operation, aimed at an assumed obstruction in the colon, gave immediate and permanent relief. In the first two stages the conditions present within the abdomen were determined by direct inspection. The history of this case has a demonstrative value rare in clinical work, and only attained as a rule in precise and carefully-planned laboratory experiments.

Let me remark especially that it clearly indicates three stages of the obstruction in ileus duplex :—

a. Stage of obstruction of the ileum alone.

b. Stage of obstruction of the ileum with paresis of the colon.

c. Stage of complete obstruction of both ileum and colon.

The late onset of the colic obstruction is an important point, to which I must return.

But it is frequently said that one case proves nothing. Let me then draw your attention more briefly to a second and later case, *Case* 11 (recorded in full on p. 181). This, too, was a case of pelvic appendicitis in a woman of

middle age, in which, though the pelvic ileum was inflamed and congested, no evidence of intestinal obstruction had manifested itself prior to the first operation. I accordingly contented myself with the removal of a gangrenous appendix, and the drainage of a pelvic collection of pus. On the fifth day after the operation complete intestinal obstruction developed. The abdomen was re-opened, a lateral ileocolostomy was performed, and, in view of the lessons of the previous case, a catheter was tied into the cæcum. After a severe struggle the patient recovered. So far this case has less probative value than the preceding one. The colic obstruction was not obvious at the operation, and a critic might assert that it would have been sufficient to short-circuit the inflamed ileum, without providing any relief by the cæcostomy for a purely hypothetical colic obstruction lower down. A very instructive incident of this patient's convalescence effectually disposes of the criticism. Shortly after the spontaneous closure of the cæcostomy opening, the abdominal distention recurred. It could not be overcome by purgatives or enemata; but after reaching a serious degree, it was spontaneously relieved by the bursting open of the recently-healed cæcal fistula.

It is impossible to inflict upon you now the detailed case-records which will be appended to the printed record of this lecture. Anticipating what I have to say on treatment, let me instead point out *Table II*, which shows that if treatment is directed only to one of the two obstructions present, death may be expected in 75 per cent of cases. But if my hypothesis of a double obstruction is acted upon, the mortality falls to 20 per cent. The evidence for the duplex character of the obstruction, derived from the two crucial cases I have given you in detail, is thus borne out by the appeal to statistical results. The fact that no two blades of grass are precisely alike, still less two cases of disease, points to the fallacy of all statistics, a fallacy which relegates them to the place of secondary or confirmatory evidence. The precise study of single cases is, in my opinion, of much greater value. But when, as in this instance, the one method of investigation confirms the other, a high degree of certainty is reached.

Prevention of Ileus Duplex.—Although, thanks to a general recognition of the need for prompt operation in appendicitis, the mortality of that disease is now becoming a residual one, it is susceptible of further reduction if the danger of ileus duplex is borne in mind in cases where the appendix is pelvic in position.

It is of great importance to detect and treat infection of the pelvis in its earlier stages. In every case of appendicitis, unless it is certain that the mischief is securely shut off by adhesions and confined to the right iliac region, a small median sub-umbilical incision should form the first step of the operation. With a pair of sponge-forceps a fold of gauze is carried to the bottom of the rectovesical or recto-uterine pouch. If no inflammatory fluid is present on the gauze when withdrawn, the finger with great caution explores the limits of the inflammatory mass in the right iliac region, thus gaining valuable information. The incision is then sewn up, and the appendix subsequently removed through an incision made over it in the usual way.

If the rule thus laid down be carried out, in a certain proportion of cases, even of localized appendix abscess, unsuspected dirty or semi-purulent fluid

will be found free in the pelvis. By the introduction of a drainage tube through the median exploratory incision to the bottom of the recto-vesical pouch, these cases will be saved from the pelvic abscess, or spreading peritonitis, or ileus duplex which they would probably have developed if the median incision had not been made.

When pelvic infection is found, it is a matter to be decided in each case whether to prolong the incision and remove the appendix through it, or to make a subsequent second incision directly over the offending organ.

Two other points must be borne in mind for the prevention of mortality from ileus duplex. At every operation for pelvic appendicitis, the ileum must be examined for inflammatory paresis and the supra-pelvic ileum for distention. After every appendix operation the nurse must be instructed to report carefully on the passage of flatus, for early recognition of ileus duplex is essential to its successful treatment.

Treatment of Ileus Duplex.—This may be conveniently studied in the light of the following table, which records the results of my experience during a period of eight years. The condition is neither rare nor common. I have met with it fourteen times among some hundreds of abdominal cases of all kinds. Though the figures of my table are small, they are, I think, very significant as to the merits of different modes of treatment. They show especially that forms of treatment which take into account only the small-intestine element in the obstruction give a high mortality. Thus, four out of six cases of simple ileocæcostomy died. The two cases which recovered indicate that the large-intestine obstruction, besides being later in onset, may not always become complete.

Table II.—Results of Treatment in the Author's Cases of Ileus Duplex. 1907–1915.

	Recovered	Died
Enterostomy	0	1
Enterostomy with ileocæcostomy ..	1	0
Ileocæcostomy alone	2	4
Ileosigmoidostomy	0	1
Colostomy alone	0	1
Ileocolostomy with cæcostomy* ..	3	0

On the other hand, I have no death to record among the three cases treated by ileocolostomy combined with cæcostomy. This is the ideal treatment. It appears to matter little whether the anastomosis is made between the ileum and cæcum, or the ileum and sigmoid, provided that in either case a safety-valve to the exterior is supplied by tying a catheter in the large intestine. I believe the anastomosis with the cæcum is safer, as being further removed from the inflamed area.

On a recent occasion, forgetful of the results of my own experience, I

* In one of these cases the cæcostomy was performed some days after the ileocolostomy, on account of the persistence of symptoms, and with immediate relief.

performed an ileosigmoidostomy for ileus duplex without draining the cæcum. The case was one of pelvic appendicitis in a woman of advanced years, with mingled signs of pelvic peritonitis and obstruction. The pelvic ileum was obviously paralyzed, but at the time of operation the pelvic colon wore a deceptively normal appearance. Lateral anastomosis of the supra-pelvic ileum with the sigmoid was followed by some days of complete relief. But the anastomosis, subject to the strain of oncoming paresis of the pelvic colon, finally yielded, and the patient died of septic peritonitis and fæcal extravasation. So difficult is it not to forget the lessons of one's own experience.

In at least one of my cases treated by ileocæcostomy and cæcostomy, natural actions of the bowels per anum occurred within a day or two of the operation. This must not be taken to prove that the drainage of the cæcum was unnecessary. It has already been shown that the colic element of the double obstruction is late in its onset, and it must be obvious, moreover, that drainage of the cæcum will relieve distention of the large intestine, and will thus facilitate its blood-supply and tend to *prevent* paralysis of the pelvic colon.

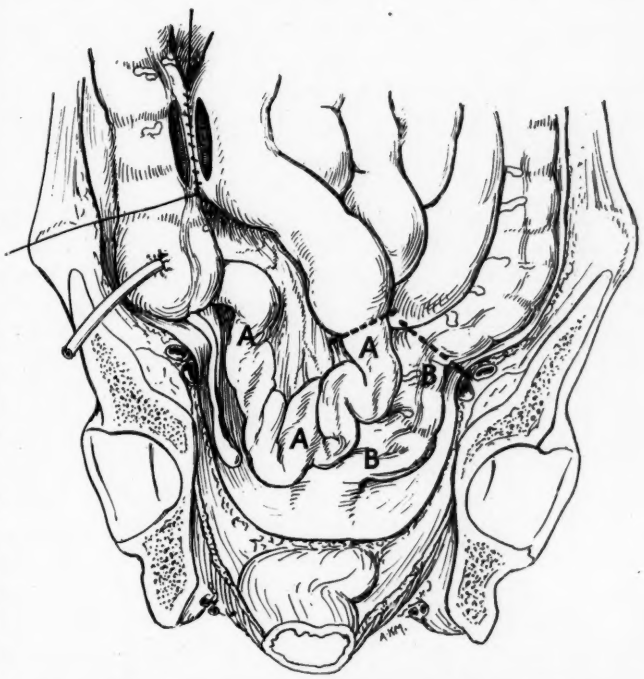

FIG. 69.—TO ILLUSTRATE THE TREATMENT OF ILEUS DUPLEX BY ILEOCOLOSTOMY COMBINED WITH CÆCOSTOMY.

A catheter has been tied into the cæcum. A A A, Paralyzed portion of small intestine. B B, Paralyzed portion of large intestine. The dotted lines indicate the level of obstruction in the ileum and in the pelvic colon.

I am prepared to admit that a cæcostomy is superfluous in a minority of cases. The recovery of two of my cases of ileocæcostomy, cases in which the cæcum was not drained, shows that the third stage, that of paralysis of the pelvic colon, does not constantly follow the others if the peritonitis is treated by pelvic drainage. But it cannot be right to trust to this in any particular case. My figures indicate that the surgeon who trusts to ileocæcostomy and peritoneal drainage alone will repent his decision in at least two out of three cases. If obstruction persists, he may still be able to save the patient by a timely cæcostomy, as two of my cases show; but the undesirability of secondary operations in patients who are acutely ill is so generally recognized as to need no emphasis. It is far better to perform simultaneous cæcostomy as a routine precaution in all cases where an ileocæcostomy is necessary.

In dealing with the large-intestine element of the obstruction, it is to be borne in mind that the obstruction is temporary only, and that in cases which recover, the large bowel will have regained its propulsive power within ten days or a fortnight at most. If during this period provision is made for the escape of gas, it appears to be unnecessary to provide for any evacuation of solids, especially as the patient will be taking only small quantities of food. For these reasons it is unnecessary to make a full-sized colostomy opening, and all needs will be met if a large rubber catheter is passed through an aperture in the wall in the colon and held in place by a purse-string suture which also transfixes the catheter. It probably matters little whether the catheter is introduced into the cæcum, or at any lower point situated above the pelvic colon. As a matter of convenience when an ileocæcostomy has been performed, the cæcum is the most accessible point to choose. Probably the best form of catheter is a so-called 'self-retaining female' catheter, since this is less likely to be blocked by fæcal débris. Should the catheter become blocked, it must be cleared by syringing through it a small amount of saline. The catheter will come out spontaneously about the fifth day, and a small cæcal fistula remains, which will rapidly close as soon as it has become superfluous.

Enterostomy.—The old treatment of enterostomy will no doubt occasionally save a case of ileus duplex. The method is, however, a crude and almost barbarous expedient. It is true that it removes the obstruction completely; but in order to do so it robs the patient of much of the nourishment elaborated in the upper intestine, and of most of the fluid taken by the mouth. This latter loss is the more important one. The effects of an enterostomy upon the patient's general condition may be compared to the effects of persistent vomiting. Even in cases where collapse and starvation are averted, the miseries the patient has to endure from the escape of the intestinal juices and their digestive action upon the skin are so great that the operation should, I think, never be performed except as a last resort. The evils of enterostomy may be diminished considerably if there is a free passage into the large intestine below it, and in one of my cases which recovered I performed an ileocæcostomy combined with an enterostomy; but though this patient recovered, his sufferings from dermatitis of the abdominal wall made me resolve to abandon the operation even when combined with an ileocæcostomy.

Jejunostomy.—In a paper to which I have already referred, Victor Bonney has advocated jejunostomy as the correct treatment for certain cases of paralytic ileus following operation, in which fæcal vomiting has made its appearance. For reasons which will appear, I think this treatment valuable, though it may prove to have a very limited range of application.

I desire to refer fully to this interesting paper for another reason, namely, that in some respects it anticipates my own observations, more especially in describing a 'primarily collapsed segment' of the bowel in cases of paralytic ileus.

It will, perhaps, be desirable to give a short summary of Bonney's paper, and to indicate the points on which I differ from him, and those on which I confirm his conclusions. In the first place, his paper restricts itself to cases of paralytic obstruction following abdominal section. Peritonitis does not appear to have been present in his cases.

He points out that flatulent distention and loss of intestinal tone is common during the first forty-eight hours after an abdominal operation, especially when traction on the mesentery has been necessary, or the operation has been a prolonged and difficult one, and that a proportion of such cases, if not treated by the rectal tube, the use of an enema, and the hypodermic injection of eserine sulphate, would terminate in paralytic ileus. In true paralytic obstruction these measures fail to relieve the condition. The pulse-rate rises and vomiting begins, at first odourless, then brownish and sour-smelling, and finally definitely fæcal. Bonney holds that the likeness of the symptoms produced to those that arise from organic obstruction depends upon the fact that in both forms the chief factor in the clinical condition is an acute ascending infection of the upper intestinal tract by *Bacillus coli* and other intestinal bacteria. The fluid vomited is derived by rapid exudation from the intestine wall, and its fæcal character is elaborated at the site of its exudation, and does not depend upon regurgitation of the contents of the bowel lower down. Accordingly, the mere removal of the obstruction, be it organic or paretic in nature, will not suffice, unless the contents of the upper intestine are also evacuated. Bonney believes that, while in organic obstruction the bowel above is always at first in a hyper-active state, making violent colicky efforts to overcome the block, in paralytic obstruction the intestinal wall is from the first inactive and incapable of peristalsis. It will be seen that Bonney apparently regards the whole length of the intestinal tract as sharing in the paralysis. In my view this condition of total paralysis is only met with in cases of general peritonitis, or in the last or ante-mortem stage of intestinal obstruction. It is, I think, of great importance to realize that in the earlier stages the actual paralysis of the gut is limited to certain definite segments. Mr. Bonney goes on to say that he and Mr. Comyns Berkeley have found that in cases of the kind he is considering, the bowel may be divided into three segments, each of which is in a different condition: (1) A primarily collapsed portion; (2) A portion above it which is distended with gas but contains no fluid matter; and (3) A portion above that, distended with fluid matter fæculent in character and identical with that vomited. The segment of primary collapse may, he says, be situated in the lower intestine, but it most usually affects the end of the ileum.

In regard to treatment, he states that it is proper in these cases to open the upper fluid-containing segment, and useless to open the middle gas-containing segment; that is to say, he advocates treatment by jejunostomy. He records a successful case in which this treatment was adopted. The patient had been operated upon for advanced carcinoma of the cervix. Paretic obstruction showed itself within twenty-four hours, and within forty-eight hours fæcal vomiting was present. The wound was re-opened. The last three feet of the ileum were collapsed and flattened, as were also the cæcum and the ascending and transverse colon, although the sigmoid contained gas in about normal amount. [The absence of any record of inflammation of the wall of the collapsed bowel leaves me in doubt whether Bonney's cases are exactly comparable to my own.] Above the segment of primarily collapsed bowel, the rest of the small intestine was greatly distended. There was no peritonitis. A gauze tube was inserted into the jejunum; the vomiting

immediately ceased, and gave place to a profuse flow of dark fæculent fluid through the tube, continuing for forty-eight hours. At the end of this time, normal jejunal contents, deeply bile-stained, began to be passed, and mouth-feeding was started. But all food taken was passed undigested through the opening within a few minutes of its ingestion, and a few days later, as the patient was approaching a condition of starvation, the wound was re-opened, the jejunal coil was freed and resected, and the operation was completed by an end-to-end anastomosis. The patient recovered.

It will be noted that this treatment is advocated by Mr. Bonney for cases only in which fæcal vomiting has begun. Although the symptom of fæcal vomiting is included in the text-books among the typical signs of intestinal obstruction, Bonney would agree that a diagnosis should be possible, as a rule, in a much earlier stage. Possibly the operation of jejunostomy may prove to be the best means of dealing with intestinal obstruction in the late stage when fæcal vomiting is present. In my own experience patients with this symptom rarely recover, and Bonney's paper may have pointed out the best way of dealing with it.

To the large majority of cases in which the diagnosis is possible earlier, Bonney himself would not apply the treatment of jejunostomy.

Ileus Duplex frequently mistaken for General Peritonitis.—When signs of intestinal paresis show themselves in cases of pelvic suppuration, it is easy to jump to the conclusion that the paresis is due to the onset of a general peritonitis, and that useful interference is limited to drainage of the peritoneal cavity. In the post-operative group of cases, as a rule, drainage has already been provided, and a diagnosis of general peritonitis means the abandonment of any further effort to save the patient.

It is a remarkable fact that in the current edition of his work on *Intestinal Obstruction*, which has been the guide of more than one generation of surgeons, Sir Frederick Treves has recanted his belief in the existence of ileus paralyticus. He says: "The sole pathology of ileus paralyticus is summed up in the assumption that a portion of the bowel has become incapable of peristaltic movements, and as a result of this, acute symptoms follow. I venture to think that ileus paralyticus, as described in the text-books and in the previous edition of this book, has no clinical existence.

"How often it is that the symptoms persist and rapid death follows the liberation of a coil of intestine strangulated by a band. Such death, however, is due to peritoneal infection or septicæmia, and not to ileus paralyticus. Those, however, who still claim that ileus paralyticus exists, would maintain that the persistence of the symptoms and the final dissolution of the patient are due to the fact that the damaged coil of intestine remains paralyzed.

"I have never met with an example of such a case as this in which a diffuse peritonitis was not met with after death."

Note that the basis for Sir Frederick Treves's disbelief in paralytic ileus is to be found in the last sentence I have quoted. He assumes that the general peritonitis found, as he truly says, in all cases at the necropsy, is the sole and sufficient cause of death, and that cases of so-called 'paralytic ileus' are really cases of general peritonitis. This false assumption, based on post-mortem

pathology, is negatived by a study of the order of events in the living abdomen. As I have shown, observations in the operating theatre show marked evidence of obstruction before the appearance of any signs of general peritonitis. The general peritonitis found after death is a late result of the obstruction. This conclusion is amply borne out by the successful results of treatment directed towards the short-circuiting of the segment or segments of bowel which are presumed to be paralyzed. On Sir Frederick Treves's hypothesis, such treatment would be absolutely useless.

The evidence on this point derived from my cases of ileus duplex is fortified by a consideration of the results of short-circuiting operations in cases of obstruction by band. It has been my practice in such cases, wherever there was definite evidence of strangulation, and after the band had been divided, to short-circuit the affected loop by a lateral anastomosis. In cases thus treated I have found that recovery is the almost invariable rule.

The question is not merely one of academic interest. To label a case of ileus duplex as general peritonitis is to make a prophecy, not a diagnosis. In the course of a few days that prophecy will deplorably fulfil itself at the cost of the patient's life. I submit that upon the question at issue the views of Sir Frederick Treves may be rightly described as reactionary, and dangerous in proportion to the distinction and authority of their author.

Diagnosis of Ileus Duplex from General Peritonitis.—Some of the ordinary criteria which distinguish general peritonitis from intestinal obstruction fail in the case of ileus duplex, since, in addition to the obstruction, pelvic peritonitis is also present. Thus general peritonitis and ileus duplex present a close general resemblance. In both conditions there are general distention, vomiting, complete constipation, raised temperature, and rapid pulse, with abdominal pain and distress, and embarrassed abdominal respiration. The points of difference between the two conditions, though few in number, are happily sufficient to distinguish them. In general peritonitis general rigidity of the anterior abdominal wall is the rule. In ileus duplex rigidity is absent, or is present only in the hypogastric region. Moreover, the diffuse tenderness of the whole abdomen which characterizes general peritonitis is not found in ileus duplex; nor does the pulse, however rapid, present the wavering quality of the peritonitic pulse.

When I speak of these differences, you will understand that I refer to the earlier stages. Ileus duplex is no exception to the rule that intestinal obstruction ends in general peritonitis.

CONCLUSIONS.

Let me now attempt to sum up my conclusions. Peritonitis of the serous surface of the intestine, when it reaches a certain degree, is accompanied by complete paralysis of the involved segment of intestine. General peritonitis means general paralysis of the intestine, and is accordingly not amenable to surgical treatment. But if the peritonitis is partial, though unlimited by any adhesion-barrier, certain segments only of the intestine are paralyzed. If the paralyzed segments can be thrown out of circuit by surgical measures, recovery is in such cases possible and even likely. Unfortunately, in these

cases the surgeon's hand has been paralyzed by a facile assumption, based upon the general abdominal distention, that general peritonitis is present.

The position of the subject in 1903 is thus summed up by Douglas: "Post-operative sepsis resulting in peritonitis produces paresis of the muscular wall of the intestine, and the resulting intestinal obstruction is the conspicuous symptom of the general peritonitis. In septic peritonitis, with conspicuous symptoms of obstruction, experience has taught us that secondary operations are so uniformly fatal that surgeons are discouraged in undertaking them. . . . Enterostomy has been frequently done without avail."[3] This pessimistic view was held by Douglas—though he recognized that the paralysis might involve only small segments of bowel—because he wrongly assumed the presence of general peritonitis in such cases.

The observations I have made in the operating theatre, and the successful results of my cases, show conclusively that septic ileus of pelvic origin is not accompanied by general peritonitis when it first comes under observation; further, that it is perfectly amenable to surgical treatment, subject to a clear recognition of the fact that two segments of the bowel are involved, and that accordingly two obstructions require to be circumvented.

It may be complained that the name ileus duplex adds a new terror to medical nomenclature. It is the acknowledged privilege of the poet to give to airy nothing a local habitation, and a name. I fail to see why the humble scientific observer, whose trammelled imagination must dance in tune with the facts of nature, may not assert at times the same right of fixing in language his comparatively dull realities. And in the present instance the name 'ileus duplex,' whatever its defects, will, I believe, give such definition and precision to the condition I have described as to hasten its general recognition, and thus help to save lives which might otherwise have been sacrificed.

CASE RECORDS.

Case 1.—**Pelvic appendicitis. Ileus duplex. Enterostomy. Death.**

On March 22, 1907, a Dutch woman, age 60, was admitted to the Middlesex Hospital with moderate general distention of the abdomen, most marked in the right iliac region. The history was vague; but distention and absolute constipation had existed for two days. There had been abdominal pain, more severe in the right side, and some vomiting. There was no visible coiling, and vaginal examination was negative. The temperature was 100°, and the pulse 96. It was thought there was a growth, with subacute obstruction. The abdomen was opened in the middle line below the umbilicus. Very distended and congested coils of small intestine, covered here and there with patches of lymph, were revealed. The hernial rings were free. A small quantity of slightly offensive flaky pus escaped from the right iliac region during an endeavour made to reach the cæcum, and here a gangrenous appendix was found extending downwards into the pelvis. There was plastic pelvic peritonitis, and the adhesion of coils of small intestine appeared to be the cause of the obstruction. The pus was washed away by a free stream of saline, and the appendix removed through the median wound. Two large drainage tubes were introduced into Douglas's pouch, and the peritoneal cavity was flushed out. As the small intestine appeared hopelessly distended, an opening was made into it near its lower end, and it was emptied by Moynihan's tube. A rubber catheter was tied into the

opening and brought out through the wound at its upper end. The small intestine, much of which had eventrated itself during this procedure, was copiously washed with saline, and returned. Six ounces of saline were given through the catheter every two hours, and a moderate amount of fluid by the mouth. The pulse after operation was about 90.

The patient died in forty-eight hours with delirium and peritonitis.

This case was probably hopeless from the first. It was one of my earliest cases, and the treatment adopted was far from being ideal. Flushing out the peritoneum was an undesirable step to take. Instead of doing an enterostomy, I should now do a lateral ileocolostomy and tie a catheter into the cæcum.

Case 2.—**Pelvic appendicitis. Ileus duplex. Ileocæcostomy. Death.**

On August 28, 1907, a man was admitted to the Middlesex Hospital with a diagnosis of appendicitis. His temperature was raised, and his pulse about 100. He had been vomiting for several days, but the vomit was not stercoraceous. There was general distention, with slight general rigidity. He had the pinched expression of an abdominal case, and his tongue was dry. Neither flatus nor fæces had been passed for several days prior to admission. No right iliac tumour could be felt, nor was there anything abnormal to be detected per rectum. Pain and tenderness were more marked in the right iliac region than elsewhere. Operation was at once performed through a long incision in the right semilunar line. The cæcum and the lower end of the ileum were found to be collapsed. The pelvic ileum was swollen, congested, collapsed, and bathed in pus. It was evidently acting as a bar to the onward passage of the intestinal contents. Higher up, the small intestine was greatly distended, and here also it was congested but had not lost its lustre. The appendix led straight down to the bottom of the rectovesical pouch, where there was a perforation surrounded by a small abscess. The appendix was removed, and a large tube was placed in the pelvis. A coil of ileum, distended but not inflamed, was now selected somewhat high up in the bowel, and a lateral anastomosis was performed between this coil and the ascending colon. The intestines were washed with saline and returned, and the incision was sewn up, the operation having lasted forty-five minutes. The salines were given every four hours per rectum, and the same evening the pulse was 96, and the patient said that he was free from pain. Signs of obstruction returned, and he died a day or two later.

This case represents pelvic appendicitis which has been allowed to reach an advanced stage. The fact that the ileum was congested as well as distended showed possibly that peritonitis was spreading upwards into the abdomen. But congestion may result from obstruction alone (see *Case* 13). The measures taken to re-establish the intestinal current were imperfect, since at the date of this case I had not appreciated the fact that there is inflammatory paresis of the sigmoid as well as of the pelvic ileum, nor had I realized the undesirability of flushing out the abdomen.

Cases 3 and 4.—**Intestinal obstruction from pelvic appendicitis.**

The notes of these cases are unfortunately lost. They were both admitted to the Middlesex Hospital, in 1907 or 1908, with a diagnosis of intestinal obstruction, which operation showed to be caused by pelvic appendicitis. In each of them the result was fatal, though lateral ileocolostomy was performed. Drainage of the large intestine (cæcostomy) might perhaps have saved them, though both were late cases; but at the time they occurred I had not realized its importance.

Case 5.—**Traumatic rupture of the bladder. Ileus duplex. Death during operation.**

A woman of middle age was admitted to the Middlesex Hospital under my care with signs of acute intestinal obstruction. No flatus had been passed for several

days. The abdomen was generally distended, but was only rigid in the hypogastric region. Here an indefinite resistance suggesting a distended bladder was present; but when a catheter was passed, only a small amount of septic urine was found in the bladder. The temperature was raised, and the pulse rapid. Vomiting was frequent and offensive. There was a vague history of a blow on the abdomen ten days previously, but since that time, and until a day or two before admission, the patient had walked about and had done her house-work. The diagnosis prior to operation was one of acute intestinal obstruction of uncertain origin, with commencing peritonitis.

When the abdomen was opened by a median hypogastric incision, the small intestines above the pelvis were found much distended and congested, but they had not lost their lustre, nor was there adequate evidence of a general peritonitis When the hand was passed down into the pelvis it encountered soft adhesions, which readily yielded and gave vent to a pelvic collection of semi-purulent fluid of strongly ammoniacal odour. The pelvic small intestine was intensely inflamed, collapsed, and evidently paralyzed. The condition of the pelvic colon was not noted. Palpation of the bladder revealed a round hole, evidently a rupture, on its posterior surface near the apex. At this moment the patient stopped breathing, the heart failed, and efforts to restore life were unavailing. It is probable, at the stage when the patient first came under treatment, that a fatal result was in any case inevitable.

Case 6.—**Pelvic appendicitis. Intestinal obstruction of some days standing. Appendectomy and ileocolostomy. Death.**

In October, 1907, at the Bolingbroke Hospital, I operated upon a man with all the symptoms of acute intestinal obstruction. The operation was delayed on account of the apparent success of an enema given on admission, but the obstruction recurred. The abdomen was generally distended, and my notes state that [it resembled that of a large intestinal obstruction becoming acute, except for the absence of visible peristalsis. A gangrenous appendix was found in the pelvis. The colon was loaded. The upper part of the small intestine was greatly distended, while the lower ileum was intensely congested and inflamed. No pus was present in the peritoneal cavity, but flakes of plastic lymph were present all over the pelvic peritoneum. Appendectomy and ileocolostomy failed to relieve the obstructive symptoms, and the patient died.

Case 7.—**Suppurative salpingitis. Paralysis of the pelvic ileum. Ileocæcostomy. Recovery.**

On December 3, 1908, I operated at the Bolingbroke Hospital on an actress, age 20. The history was doubtful and misleading, but for forty-eight hours she had suffered from complete constipation, in spite of enemas, and from bilious vomiting. The abdomen was flat and rigid, the temperature raised, and the pulse quick. The question of a ruptured gastric ulcer was raised, but there was no gas in the abdomen, and there were no localizing signs. There was a history of gonorrhœa, and a vaginal discharge was present.

The abdomen was opened in the middle line just below the umbilicus. The peritoneum was thickened and œdematous, and bled very easily. A little turbid fluid escaped on opening the peritoneum. A finger cautiously introduced upwards found normal and unadherent viscera, except that the small intestine was much distended. Gauze was packed in to protect the upper part of the abdomen, and the incision was prolonged to the pubes. Here the coils of the intestine were glued to each other by recent adhesions, and one or two collections of turbid fluid were evacuated from between them. The pelvis was filled by coils of intensely inflamed and congested small intestine, covered with yellowish lymph, which presented here and there very sharp kinks between the adjacent coils. This part of the bowel was very œdematous, but not distended. The inflammation invaded the lower three feet of the ileum, but its lowest four inches were normal and collapsed, as was also the cæcum. The appendix was normal. Above the inflamed part of the ileum there was very great distention of the small intestine, but its surface was smooth and not congested. With some difficulty the Fallopian tubes were brought up. They were behind, and intensely inflamed and swollen. Clearly the case was one

of ascending genital inflammation, with complete inflammatory obstruction of the ileum. Two large tubes were placed in Douglas's pouch. The ileum in the inflamed part was anastomosed laterally with the cæcum. Within forty-eight hours the patient had a normal motion, and had lost her pain and discomfort. A free discharge of pus took place for three weeks through the pelvic drainage tubes. The patient ultimately made an excellent recovery.

Case 8.—*This has been recorded in full on* p. 167.

Case 9.—**Pelvic appendicitis. Ileus duplex. Ileocæcostomy. Recovery.**

Abraham M., age 19, was admitted to the Middlesex Hospital on October 7, 1911, with a history that early in 1910 he had suffered with pain in the right iliac region for about a week. The day before admission an exactly similar pain returned, and he vomited several times. No flatus had been passed for twenty-four hours before admission. The pain became general over the lower part of the abdomen, and he passed a very restless night. On his admission at 7.0 p.m. his temperature was normal, and his pulse 128. The abdomen did not move well with respiration. It was slightly tender all over, very tender and slightly rigid over the right iliac fossa. In the rectum a small swelling could be felt on the right side. The whole rectum was very tender. Save for the slight rigidity in the right iliac region, the case would probably have been diagnosed as one of non-inflammatory intestinal obstruction. The abdomen was opened in the middle line, and pus of a faintly fœtid odour escaped. A drainage tube was introduced into the pelvis. A second incision was made internally to the right anterior superior spine, and the appendix was found passing downwards into the pelvis. The tip was swollen, perforated, and gangrenous. The lower loops of the ileum hanging down into the pelvis were œdematous, swollen, and congested, but collapsed rather than distended. Above these loops the ileum was considerably distended, but not inflamed. It was evident that complete obstruction was present. A lateral anastomosis was carefully made between a distended coil of ileum and the cæcum.

The after-treatment included, as usual, Fowler's position and rectal saline. The following day the patient was much better, and flatus passed freely from the bowel; the day after, the pulse fell to 88.

Staphylococci and Gram-positive diphtheroid bacilli were found in culture.

The patient made a good recovery, and left the Hospital about three weeks after the operation.

In respect to this case I would remark that probably some of the fatalities following operation for appendicitis depend upon the non-recognition of the signs of early intestinal obstruction produced in the way I have described. No operation for appendicitis should be considered complete until the condition of the ileum with respect to distention has been investigated, more especially if on enquiry prior to operation the patient states that flatus has not passed for twenty-four hours, or more. This point seems to me of great importance.

Case 10.—**Pelvic appendicitis. Ileus duplex. Ileocolostomy with enterostomy above. Recovery. Death later from acute caseating tubercle.**

William B., age 28, was admitted to Helena Ward on March 17, 1912, with a history of pain in the lower abdomen—not definitely unilateral—and vomiting, dating from March 12. The patient was a healthy-looking man with no history of previous illness.

On admission his pulse was 92 and his temperature 100·6°. An hour or two later his pulse had fallen to normal. His tongue was dry and furred; the abdomen was generally distended but not rigid, with moderate hypogastric tenderness, not more marked on the right side than on the left. No swelling could be felt in the right iliac fossa or elsewhere.

On examination by the rectum there was marked resistance on the right side, and acute tenderness. The patient also stated that he had had pain on passing urine. As regards the passing of flatus his statements were somewhat vague; but he said that he had not passed any during the last eighteen hours. A diagnosis of pelvic appendicitis was made.

On opening the abdomen, congested and distended coils of small intestine presented themselves. After packing off the upper abdomen, the finger was placed in the pelvis and about half a pint of thick, stinking pus was evacuated. Several small collections of pus were also encountered among the coils of intestine in the pelvis.

The pelvic ileum was thickened, œdematous, inflamed, and obviously paralyzed. A gangrenous appendix was found hanging into the recto-vesical pouch, and was removed. The upper ileum was now examined. It was not inflamed, but was much distended. Obviously the pelvic ileum was the cause of complete obstruction. A lateral ileocolostomy was therefore performed between the uninflamed part of the ileum and the cæcum. A catheter was then tied into the ileum just above the anastomosis, and was brought out through the upper end of the abdominal wound. Two large pelvic drainage tubes were introduced, and the abdomen was closed.

The prognosis, though not hopeless, was thought to be extremely grave. At 11.0 p.m. the patient was greatly distended, and a twenty-fifth of a grain of salicylate of eserine was injected hypodermically; flatus was passed almost immediately through the catheter. He was ordered continuous saline, and kept on passing flatus by the catheter. On March 20 the temperature rose to 102·2° and the respiration to 30, and the patient was slightly cyanosed. On examination of the chest there was absolute dullness to percussion on the right base and slight dullness on the left. Tubular breathing was audible over the right of the base, and Sir James Fowler, who saw the patient the following day, thought there was a patch of pneumonia on the right base, with fluid at the left base. He suggested aspiration of the left pleura; this was done, and two ounces of pus were drawn off. On March 24 the temperature fell to 99°, and the respiration to 22. The catheter became loose and was removed, and a fæcal fistula resulted. Subsequently the temperature, after falling to normal for some days, rose again, and remained high until the death. On March 30 the drainage tube was removed, and the wound subsequently healed except for a small hole corresponding to the enterostomy. On April 1 Sir James Fowler could find no adventitious signs in the lungs, but on April 16 Dr. Lakin found tubular breathing over the left base. Death occurred on April 20. The post-mortem examination revealed the abdominal cavity in a normal condition except for the tiny opening of the fæcal fistula. There was acute caseating tubercle over the whole of both lungs.

I am indebted to Mr. J. Titmas, Resident Medical Officer to the Putney Hospital, and formerly House Surgeon to the Middlesex Hospital, for the notes of the case.

This case must be accounted a successful one so far as the appendicitis was concerned, for the patient died of an independent disease. But I do not think that I was wise in making the enterostomy above my lateral anastomosis. The opening displayed little tendency to close, although there was the lateral anastomosis below it to minimize the escape of fluid. The discharges were very troublesome and irritating to the skin, and the patient's nutrition was not satisfactorily maintained, a fact which may have predisposed him to acute infection from some old tuberculous lesion. I am more than ever convinced from this case that an enterostomy, even when combined with a lateral anastomosis lower down, is thoroughly bad treatment in all acute abdominal conditions save in those desperate cases where it is the last resort.

Case 11.—**Pelvic appendicitis. Appendectomy followed by signs of ileus duplex. Ileocæcostomy with cæcostomy. Spontaneous closure of cæcostomy followed by recurrence of symptoms. Immediate relief after spontaneous re-opening of the cæcostomy. Recovery.**

In May, 1912, I was asked by Dr. R. Oram, of Wandsworth, to see a lady, Mrs. F., age 57. For ten years the patient had suffered at intervals from mild attacks of pain in the right iliac fossa, and had ascribed them to indigestion. For ten days she had complained of subacute abdominal pain of colicky character. On admission to the Bolingbroke Hospital her temperature was 100·4°, pulse 98, and respirations 24. The whole abdomen was tender but not rigid. The tenderness was most marked in the middle line below the umbilicus. No special tenderness was detected in the right iliac fossa, nor could a tumour be felt there. Rectal examination detected a swelling to the right of the uterus, and a diagnosis of pelvic appendicitis was arrived at. There was some difficulty in the passage of flatus, but no absolute constipation. On June 12, seventy-two hours after the onset of acute symptoms, the abdomen was opened at the outer edge of the right rectus, and a gangrenous appendix was found extending downwards almost to the floor of the pouch of Douglas. Offensive purulent fluid welled up from the pelvis. The appendix was removed, and a large drainage tube was left in the pelvic cavity, while a smaller one extended to the stump of the appendix. It was noted at the time of the operation that about two feet of the lower ileum were congested and œdematous, but as the small intestine above was not distended or inflamed, it was thought unnecessary to do a lateral anastomosis. As will be seen, this proved to be an error of judgement. On the third day the tube to the appendix region was removed. The pelvic tube continued to discharge freely a thin offensive sanguineo-purulent fluid. The temperature gradually fell, reaching normal on the fifth day. The bowels acted on the second day in response to calomel. On the fifth day the patient complained of severe colicky abdominal pain, and the abdomen became rapidly distended. Enemas and purgatives failed to produce an action of the bowels, and complete obstruction was evidently present, although there had been no vomiting.

On June 17 the abdomen was reopened by a median incision below the umbilicus. The lower three feet of the ileum were found to be acutely inflamed, and in a state of paralytic collapse. The ileum above was much distended, but not inflamed. This portion of the bowel was evacuated through a puncture, and a lateral anastomosis was made between the supra-pelvic ileum and the ascending colon, well above the zone of inflammation. A No. 12 rubber catheter was introduced into the cæcum through a puncture, and was tied in by a purse-string suture and brought out at the median incision. The after-treatment included continuous rectal saline, pituitrin, and eserine. The operation at first produced great relief, but on June 19, perhaps owing to obstruction of the catheter, distention recurred and her condition became very grave. At this time, indeed, it appeared so hopeless that I considered giving her morphia to ease her last moments. Turpentine enemas and eserine had failed to relieve the distention; but a repetition of the enema was at last followed by a free passage of flatus. On June 21, a little fæcal matter was noticed oozing from both incisions, probably from leakage round the catheter. An ounce of castor oil given by the mouth produced a fluid action through the catheter. The distention was less. On June 26, the catheter in the cæcum came out, leaving a fistula. The patient, after hovering between life and death for several weeks, eventually made a good recovery, thanks mainly to the skill of my house surgeon at the Bolingbroke Hospital, Mr. L. S. McBride, and to the devotion of the nurses. The large intestine fistula closed spontaneously about the middle of July. Shortly after its closure an event occurred which proved that it had been essential as a safety-valve. The abdominal distention recurred, and the patient's condition appeared serious until she was spontaneously relieved by the bursting open of the recently healed cæcal fistula. It was again allowed to close, and no further trouble of the kind occurred.

The history of this case, like that of *Case* 8, shows conclusively that intestinal obstruction in pelvic appendicitis is not situated only in the lower ileum, but that the large intestine, or a portion of it, is also paretic.

Case 12.—**Inoperable carcinoma of rectum. Colostomy. Pelvic suppuration. Ileus duplex. Death.**

Mrs. P., age 41, in April, 1913, began to pass blood per anum. She consulted a lady doctor, who made a diagnosis of piles; but not improving under treatment, she went to see Dr. Lawson, of Hornsey, who, on examination, found a growth in the rectum and advised operation. The patient declined this advice, but remained under Dr. Lawson's care for about a year, when, owing to a change of address, she came under the care of Dr. Gardner, of Streatham. At this time she was passing considerable quantities of blood and purulent matter in the motions, and suffered much from rectal tenesmus. I first saw her in consultation with Dr. Gardner in May, 1914. At this time there was a dense mass of growth involving the peri-anal skin and extending for some distance up the bowel. Its upper limits could not be determined owing to the pain caused by examination, but it was absolutely fixed and inoperable. She was beginning to have slight distention, and the bowels were opened with increasing difficulty. It was decided to perform a colostomy, and this was done at the Putney Hospital on May 1, 1914. On the fourth day the colon was opened by Dr. Newman, since the distention was beginning to be uncomfortable. Half an ounce of castor oil was given by the mouth, and 1 c.c. pituitary was given simultaneously; but the expected relief was not obtained. Accordingly, the following day small hourly doses of calomel were given by the mouth and one-fiftieth of a grain of eserine was given hypodermically, still without result. On the sixth day one of the stitches was removed, since it appeared to be a possible cause of obstruction of the opening in the colon. A turpentine enema was given through the colotomy wound with a good result, and the abdominal distention was relieved. Again it recurred, and was again relieved by enema. On the seventh day, when I saw the patient, there was still distention and difficulty in getting an action of the bowels, and the diagnosis lay between a general peritonitis, and inflammatory obstruction of the lower end of the ileum due to a pelvic peritonitis originating in bacterial penetration of the rectum in the region of the ulcerated growth. Although distention was present, there was no muscular rigidity, and the pulse, though over 100, did not appear sufficiently rapid and peritonitic in character to lead to the diagnosis of peritonitis. My diagnosis was therefore enterocolic ileus, although in this particluar case the colic obstruction was nullified by the colotomy opening. At this stage I ought no doubt to have re-opened the abdomen and performed a lateral anastomosis between the ileum and the ascending colon. The obstruction was not, however, complete, since it yielded temporarily to the use of enemata, and I was very loth to subject the patient to another operation. Eserine and enemata were continued, and on the eighth day the colotomy again acted freely, the abdomen became flat, and the patient was distinctly improved. On the tenth day she was not so well, the abdomen was again distended, and was again relieved by an enema. The pulse was more rapid, but there was no vomiting. On the eleventh day she rather suddenly became much worse, with a subnormal temperature and a feeble and rapid pulse; saline was given subcutaneously. The colotomy continued to give escape to fluid motions. The stomach was washed out at night without much result, although the fluid contained in it was greenish and offensive. The patient did not rally, and died on the twelfth day after operation.

I was present at the necropsy made by Dr. Newman. Round the colotomy wound there was a certain amount of plastic peritonitis, and some clear fluid was present in the abdomen. On passing the hand down into the pelvis, pus welled up from the region of the rectal growth. The small intestine as far down as the brim of the pelvis was markedly distended, but not inflamed. The pelvic ileum was intensely red, congested, and inflamed, with a thickened œdematous wall, and was collapsed rather than distended. The large intestine was collapsed.

This case shows enterocolic ileus arising from an unusual cause. The pelvic peritonitis was not sufficiently severe to cause absolute obstruction of the ileum, and accordingly purgatives and enemata continued to have some effect almost to the time of death. In such cases it is very difficult to decide

at what period it is advisable to abandon medical treatment and resort to operation. If, as in this case, medical treatment is persisted in, the patient may rapidly become so ill as to forbid operative interference. It would no doubt have been better to operate as soon as the diagnosis was made; but in view of the patient's miserable condition from the growth, the fatal result could not be greatly deplored.

Case 13.—**Pelvic appendicitis. Inflammatory paralysis of the lower ileum. Ileo-sigmoidostomy. Temporary relief. Death from leakage at the site of anastomosis.**

Lucy H., age 68, was admitted to Queen Ward, Middlesex Hospital, under my care, on Monday, October 19, 1914. There was a history of vague pain in the abdomen of about three weeks. No flatus had been passed for about forty-eight hours prior to admission, and the abdomen was more or less definitely tender and rigid in the lower part—not, however, more so on the right side than on the left. There was marked distention, and the expression was anxious. The pulse was 88 and the temperature 100°. The patient gave a history of chronic constipation extending back for years. Pelvic examination gave a negative result, except for tenderness in Douglas's pouch. The patient had vomited repeatedly, but the vomit was not fæcal. The signs and symptoms were consistent either with peritonitis followed by secondary obstruction, or with a primary obstruction leading to peritonitis of the lower abdomen. In view of the patient's age a malignant growth seemed the most likely cause of the symptoms, but the possibility of appendicitis was kept in mind. Shortly after admission the abdomen was opened in the middle line below the umbilicus. Pus was found oozing up from the pelvis. On passing the hand into the latter, a gangrenous appendix was found adherent to the right wall of the pelvis and bathed in pus. A portion of the ileum which hung down into the pelvis was inflamed and œdematous. Its surface presented flakes of lymph and it was intensely congested, but this portion of the bowel was not distended. The supra-pelvic ileum was distended, but not congested or inflamed. The sigmoid flexure was carefully examined, but since the inflammatory process was more or less confined to the right half of the pelvis, it was not inflamed. The appendix was removed and a drainage tube inserted into the pelvic cavity. A coil of distended but uninflamed ileum was chosen as far down as possible, and a lateral anastomosis was performed between it and the pelvic colon. The operation was followed by slight shock, the temperature falling to 97·5°, and the pulse rising to 100. After getting back to the ward the patient had an injection of one-fortieth of a grain of eserine salicylate, and within the next few hours she had several actions of the bowels, the motions being diarrhœal in character. This diarrhœa persisted for several days. On the third day after operation the temperature had risen to 100° at 2.0 p.m., but at 10.0 p.m. it dropped, and remained subnormal until death. At this time, no doubt, leakage occurred at the seat of the anastomosis. The pulse rose to 124. The mental aspect of the patient was bad, as she did not think her recovery probable or desirable. The stitches were removed on the morning of the tenth day, and at about 3.0 p.m. the same afternoon she become collapsed, and two hours later a fæcal fistula developed, and about two pints of fæculent material escaped. She died about 9.0 p.m. Unfortunately no post-mortem examination could be obtained.

For most of the notes on this case I am indebted to Mr. I. H. Lloyd Williams.

It is probable that this case would have had a happier issue if I had followed out my routine plan of ileocæcostomy with cæcostomy. It seems likely that inflammation and consequent obstruction of the pelvic colon is later in developing than the same condition in the pelvic ileum; several of my cases bear out this inference. On the third day the paresis of the pelvic colon had become definite, with a consequent rise of pressure within the bowel which the anastomosis was unable to withstand. It is to be remarked that an anastomosis made within the inflammatory area is much more likely to

yield than one made well above the pelvis and outside the zone of inflammation. Thus for two reasons ileosigmoidostomy is unsound treatment in these cases: firstly, because inflammatory paresis may subsequently attack the bowel below it; and secondly, because the anastomosis is placed in a dangerous area.

Case 14.—**Acute pelvic appendicitis in a patient the subject of phthisis. Paralysis of the pelvic ileum. Appendectomy with ileocæcostomy and cæcostomy. Recovery.**

On January 28, 1915, I was asked by Dr. Julius Moore to see a boy, age 17, who for several weeks had complained of colicky pain in the lower abdomen. Twelve hours before I saw him he vomited, and the vomiting was repeated. No flatus had passed for thirty hours prior to operation, and he had suffered very acute pain in micturition. The abdomen was not distended. It was slightly rigid in the lower part, not more on the right side than on the left. A resistance could be felt in the right iliac fossa, probably due to enlarged glands. Rectal examination was negative. The abdomen moved with respiration. The worst feature of the case was the pulse, which during the whole day had remained at about 140. The patient had suffered from phthisis for a long time. His temperature was 102°. The abdomen was opened in the middle line, and, as was expected, a gangrenous and perforated appendix was found leading down to the bottom of the pelvic cavity. The whole of the pelvic ileum was collapsed, œdematous, and partly covered by flakes of lymph which caused its coils to adhere one to another, producing very definite and sharp kinks. The ileum above the pelvis was somewhat distended, but had not lost its lustre. It was, however, distinctly congested. A quantity of offensive pus was evacuated from the pelvis. It seemed almost certain that the case would go on to ileus duplex; I therefore performed a lateral ileocæcostomy, and tied a catheter into the cæcum, bringing it out through a stab wound. At the end of the operation the pulse was 84, and much improved. The patient was to have rectal saline and subcutaneous injections of eserine if necessary. The prognosis was thought to be very grave, since the congestion of the upper ileum seemed to indicate a spreading peritonitis. Nevertheless the patient made an excellent recovery, under the care of Dr. Vandermin, of Enfield. The catheter came out of the cæcum on the sixth day, and the cæcostomy closed spontaneously on the sixteenth day. During the time it was open it gave vent to flatus only.

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THE CLINICAL ASPECTS OF VISCEROPTOSIS.

By ALBERT J. WALTON, London.

It has been the experience of all surgeons to meet with cases presenting the symptoms of some acute or chronic abdominal lesion which at operation fail to show the expected pathological change. Until a few years ago it was customary to believe that an error of diagnosis had been made and that a laparotomy had been performed unjustifiably. For this reason but few of these cases were reported, and our knowledge of the cause of the symptoms remained uncertain. Gradually, however, it became clear that the majority could be grouped together in so far as they presented definite lesions, and increasing experience has shown that, although the symptoms might vary considerably, these pathological changes are remarkably constant. As soon as this fact became evident, attention was more fully directed to the subject, so that the existence of this group of cases is now well recognized. The conditions discovered at operation have been frequently described, and many terms have been applied to the changes found in one or more areas.

Wilms[24] believes that the symptoms are largely due to excessive mobility and dilatation of the cæcum. Jackson[13] has described fully an abnormal and characteristic membrane found on the anterior wall of the cæcum, and has shown how this membrane, which had previously been described as the parietocolic membrane by Jonnesco and Juvara,[14] might be the cause of clinical symptoms. Payr[18] has given a detailed description of a somewhat similar membrane in the region of the splenic flexure. The changes found on the under surface of the mesentery of the terminal ilium have had much attention directed to them by the full and descriptive account given by Sir Arbuthnot Lane,[15] and somewhat similar bands and adhesions in the region of the pelvic colon and the left broad ligament in the female have been described by Toldt, Gray,[8] and others.

A great deal of work has been carried out to determine what is the cause of these pathological changes, the disease being at various times described as Payr's disease, Jackson's membrane, 'intestinal stasis,' 'auto-intoxication,' or the 'chronic abdomen.' As a result of this work several distinct views have materialized, viz. :—

1. *That the bands and adhesions are the result of chronic intestinal stasis.*

This view has been largely supported by Lane.[15] He believes that owing to the stasis there is a tendency for the viscera to drop, and that the adhesions are formed as an attempt to overcome this ptosis: that they may in fact be regarded as a crystallization of the lines of strain.

2. *That the pathological conditions are dependent upon the presence of chronic inflammatory changes.*

Jackson believed that the membrane he described was due to separation of the peritoneal covering owing to lymph stasis. That the other membranes

are also inflammatory is a view which has gained considerable credence, being supported by such authorities as Binnie,[2] Pilcher,[19] Gerster,[7] Hertzler,[11] and Hofmeister.[12] Although this view is not now so widely held, it has of late been revived in a somewhat modified form by Adami.[1]

3. *That the membranes and bands are of congenital origin.*

Evidence in favour of this view is accumulating, although there is still some divergence of opinion as to the nature of the developmental changes. Thus, Coffey[4] regards the persistence of congenitally long mesenteries as the primary condition, the bands and adhesions being a physiological attempt to overcome the congenital fault. Both Flint[6] and Morley[17] consider that the condition is a combination of a congenital mesentery and a prolongation of the attachment of the omentum over the ascending colon, the latter giving rise to Jackson's membrane. Eisendrath and Schnoor[5] hold a similar view, believing that the membrane is a reduplication of a fold constantly found in the fœtus. Mayo[16] believes on the other hand that the cæcum and lower end of the ileum have burrowed behind the posterior parietal peritoneum, which persists as the Jackson's membrane. Gray and Anderson[9] have moreover brought forward considerable evidence to show that these membranes are due to excess of the physiological fusion which normally takes place in embryonic life between various portions of the peritoneal sac. Reid,[21] in his researches upon the genito-mesenteric fold, has pointed out that this structure has attachments very similar to those of the band described by Lane as giving rise to kinking of the lower ileum, and suggests that in all probability it is the forerunner of this band. Pringle[20] has done much to make the pathology clear by showing that there are two factors present, firstly the visceroptosis, and secondly the bands and adhesions.

This brief description of the views which are still held, will show that the pathological aspect has excited considerable interest, and in fact a very large number of communications have been published on the subject in recent years—so much so that but little can be added to the present state of the discussion. Without entering further into the matter, it is sufficient to state that in my own experience all such cases are associated with well-marked visceroptosis, so that this factor would appear to be the primary one, which later may be associated with one or more of the bands or membranes already mentioned. It is for this reason that the condition appears to me to be more suitably described under the term 'visceroptosis.' In many cases the characteristic changes are seen at quite an early age and are apparently congenital. In others they appear to be acquired.

Although so much attention has been directed to the pathological changes, comparatively little interest has been taken in the clinical aspects of the disease. It is true that Sir Arbuthnot Lane[15] has described fully the symptoms of advanced intestinal stasis, and has brought forward a certain amount of evidence to show that many, or, in fact, most diseases are to a large extent dependent upon auto-intoxication from the affected intestine. His claims, however, have not gained general credence; and although many now recognize that the lesions described do give rise to clinical symptoms which are often mistaken for those of other conditions, yet no attempt has been made to analyze these

cases or to show how they simulate, and how they can be distinguished from, other lesions.

Although but few cases of marked intestinal stasis have fallen under my observation, yet a considerable number of the minor degrees of this disease have come to me for treatment in the last few years; and since the majority were sent with another diagnosis, it has become more and more clear that the symptoms fall into several groups as they simulate one or other of the more readily recognized abdominal lesions. Although in the earlier cases it was impossible to make a clear diagnosis, a careful study of the symptoms of each one has shown more and more clearly that the mimicry is incomplete. Indeed, were it not for the fact that the condition of visceroptosis is occasionally associated with gall-stones or with gastric or duodenal ulcer, there would be little or no difficulty in deciding that an individual case was one of visceroptosis.

It is for the purpose of throwing light upon this question of differential diagnosis that the following cases have been analyzed. They have all occurred in hospital and private practice during the last four years, and number sixty-seven in all. They have been divided into the following groups according to the disease they simulate: (1) *Cases resembling appendicitis;* (2) *Cases resembling gastric ulcer;* (3) *Cases resembling gall-stones;* (4) *Cases resembling gastric carcinoma.*

CASES RESEMBLING APPENDICITIS.

There have been 29 cases of visceroptosis which at some time were diagnosed as appendicitis. The majority were sent up to hospital or to consultation with this diagnosis, and owing to the close resemblance of the symptoms, the earlier cases were operated upon in the belief that this condition was present. In some, however, and more especially in the later ones, it has been possible to make a correct diagnosis before operation was performed.

The relative frequency of the condition to appendicitis is shown by the fact that during the same period of time there have been in my own practice 373 cases of true appendicitis.

Of the 29 cases, 13 have resembled acute and 16 chronic appendicitis; but this group does not include cases of true chronic or acute appendicitis in which visceroptosis was also present, a combination which is not at all uncommon.

Acute Appendicitis.—The clinical resemblance of visceroptosis to acute appendicitis has attracted but little attention. It has probably been the lot of every surgeon to operate on cases which he believed to be acute appendicitis in which the appendix itself was found to be in a more or less normal state. Such cases have, however, not found their way into medical literature, probably because most surgeons have been shy of recording what they have considered a weakness in their diagnostic capabilities, and possibly because the cases have been regarded simply as intestinal colic. Moreover, it does not appear to be sufficiently recognized that the changes about to be described may occur in young patients, although a suspicion of the presence of some unrecognized lesion is not uncommonly raised owing to the fact that the symptoms tend to recur a few months after appendicectomy.

It is of interest to note that of the 13 cases in this series only 2 were males, and only 1 case was over the age of twenty-two, this patient being forty-

four. The majority were relatively young, the average age being seventeen, and the youngest patient was only four years old. In many cases there was only one attack, this being the one for which the patient sought treatment. Occasionally there would be a history of three or four previous attacks which had persisted from a few days up to one or two weeks, and in several of these the attack had been previously diagnosed as appendicitis but the patient had not been operated upon.

In a typical case there would be an onset of severe abdominal pain, at first diffuse but later becoming localized to the right iliac fossa. This pain would often be present for two or three days before the patient sought treatment. During this time vomiting and constipation would be noted.

On admission, the patient would show a certain amount of pyrexia, but rarely to a marked degree. In one case the temperature had risen to 102°, but in the majority it was about 99°. The pulse would be correspondingly raised, and there would be more or less constant pain in the right iliac fossa.

On examination, there was in all cases deep tenderness situated in the region of the appendix. In 4 cases there was, in addition, the characteristic superficial tenderness found with a dilated appendix—that is to say, it commenced above and externally in the region of the anterior superior spine, and passed downwards and inwards for a distance of three or four inches along the line of Poupart's ligament, extending above and below this structure for a distance of a half to one inch. In 5 cases well-marked rigidity was noted in the right iliac fossa, but in no case was there any definite swelling such as may be found when an appendix abscess is present. This was true even when the symptoms had been present for eight or nine days; and since one would expect that an acute appendicitis of such duration would have led to the formation of an abscess, the absence of such a sign should give rise to the suspicion that the case was not one of true appendicitis.

At operation, the appendix was in every case found free from any acute inflammatory change In certain cases there might be a few adhesions; but if so, these were membranous in character and were manifestly but the continuation of the Jackson's membrane. In the majority the appendix was free, and perfectly healthy in appearance. The cases were, however, all characterized by the fact that the cæcum was remarkably mobile. It frequently happened that this viscus together with the terminal portion of the ileum could be withdrawn from the abdominal wound for a distance of six to eight inches, and in many cases the whole of the ascending colon and the hepatic flexure could likewise be withdrawn. Covering the outer and anterior surface of the cæcum was a thin membranous layer containing large numbers of small capillary vessels running obliquely downwards and inwards across the cæcum. This membrane had all the characters which Jackson has so fully described, and was freely movable and capable of being lifted off the underlying viscus. The kidney on the right side sometimes showed an undue mobility; and in two cases there was a well-marked accessory membrane on the under surface of the mesentery of the terminal ileum, the so-called Lane's kink. The presence of this definite visceroptosis and Lane's kink at so early an age would suggest that in these cases at least the condition was congenital.

The operative procedures consisted of removal of the appendix, and

division of any well-marked bands. In spite of the simplicity of this procedure, every case showed within twelve hours a return of the temperature to normal and cessation of the iliac pain, so much so that one would be inclined to believe that there was in reality an early stage of appendicitis which showed little or no evidence to the naked eye. Microscopical sections, however, showed in no case any definite inflammatory change, neither was there anything abnormal to be seen within the lumen of the appendix.

Not only was there an immediate fall of the temperature to normal after the operation, but the patient in all cases underwent a rapid recovery, and was discharged on the tenth or eleventh day free from all symptoms. This freedom as a rule continued for a month or six weeks; but it not infrequently happened that after this period there would be a return to some extent of the attacks of abdominal pain. Of the 13 cases in this series, 7 showed such evidence of recurrence. The patient would seek further treatment because of mild attacks of colicky pain, sometimes associated with vomiting. Generally these attacks could be relieved by the use of liquid paraffin and the administration of abdominal massage and exercise, combined with the use of an abdominal belt.

ILLUSTRATIVE CASES.

Case 1.—C. P., male, age 13, stated that on August 14, 1914, there was a sudden onset of severe pain in the lower abdomen. At first it was most marked in the left iliac region, but passed from there to the right iliac fossa. The attack lasted for a week, and he then remained free from pain until the end of September of the same year, when there was a second attack, lasting about the same time. In neither attack was there any vomiting. On Dec. 14 a third attack commenced, and on Dec. 16 he was admitted to hospital.

On admission, his temperature was 100° and his pulse 124. He complained of tenderness in the right iliac fossa. There had been no vomiting.

At operation, the appendix was two inches long and was apparently healthy, with the exception of some membranous adhesions which bound it to the outer side of the cæcum. The cæcum itself was extremely movable, and covered with a typical Jackson's membrane. There was a well-marked Lane's kink. The appendix was removed, and the membrane on the under surface of the mesentery binding down the ileum divided. The wound was closed without drainage.

The next day the temperature had fallen to normal, and he made an uninterrupted recovery. He remained perfectly well for a month, but after this time had one or two mild attacks of pain similar to the previous attacks. These were in part relieved by the administration of liquid paraffin.

Case 2.—M. A., female, age 22, was first seen on Aug. 7, 1913, having been ill for one day. The illness commenced with a sudden onset of pain in the lower abdomen and the right iliac fossa. She had vomited several times. Two weeks before admission there had been a similar attack lasting two days.

On admission, the temperature was 101° and the pulse 116. There was slight superficial tenderness in the appendix area and deep tenderness in the right iliac fossa.

At operation, the cæcum was found to be freely movable and showed a long mesentery. There was a well-marked Jackson's membrane passing over the whole of the cæcum to the outer abdominal wall and covering in the appendix. The appendix was otherwise normal, but was removed. The Jackson's membrane was divided.

Next day the temperature fell to normal, and the patient made an uninterrupted recovery, being discharged on the tenth day. She continued to have slight attacks of abdominal pain until eight months after operation, when she was lost sight of.

NAME, AGE, SEX, DATE	LENGTH OF ILLNESS	PERIODICITY OF SYMPTOMS	PAIN	VOMITING	PYREXIA	PHYSICAL SIGNS
No. 1. G. C., 18, Male. 22. 9. 1912	Four years	Five attacks lasting four days to four weeks	Right iliac fossa, severe	Never	T. 99°	Superficial tenderness. Deep tenderness and rigidity
No. 2. I. B., 9, Female. 4. 11. 1912	One year	Several short attacks one to two days. Last attack two weeks	R. I. F. (limited to), severe	Two days last attack	T. 99°	Tenderness R. I. F. Gurgling cæcum
No. 3. M. G., 16, Female. 8. 11. 1912	Ten days	One attack lasting ten days	Started at umbilicus, passed to R. I. F. Never severe; in bed six days only	None	T. 99°	Deep tenderness R. I. F.
No. 4. F. U., 16, Female. 13. 6. 1913	Six years	Seven attacks lasting few days only. Present attack seven days	Spasmodic five days. Continued two days R. I. F.	None	T. 99°	Tenderness and rigidity R. I. F. Cæcum dilated
No. 5. M. A., 22, Female. 8. 7. 1913	Two weeks	Two attacks. First, two days. Present one, one day	Severe, hypogastrium and R.I.F.	Several times	T. 101° P. 116	Superficial tenderness appendix area. Deep tenderness R. I. F.
No. 6. L. H., 4, Female. 5. 8. 1913	One day	One attack (first)	Severe abdominal pain one day. Could not bear to be touched	Several times	T. 102° P. 142	Tenderness and rigidity lower abdomen, chiefly R. I. F. No tumour
No. 7. W. M., 18, Female. 16. 1. 1914	One day	First attack	Severe, R. I. F.	Several times	T. 100°	Superficial and deep tenderness. Rigidity R. I. F.
No. 8. N. G., 12, Female. 7. 5. 1914	Six months	Two attacks. Both lasted one week. Diagnosed as 'appendicitis.' Last attack three months ago	Lower abdomen, chiefly R. I. F.	In each attack severe	T. 101° in each attack	Slight tenderness R.I.F.
No. 9. V. T., 22, Female. 20. 6. 1914	Two months	Frequent attacks every few days	Severe, R. I. F.	In nearly all attacks	T. 100° P. 124	Superficial and deep tenderness R. I. F. Distended cæcum
No. 10. C. W., 19, Female. 19. 8. 1914	Two months	Three attacks. First, three weeks. Free, two weeks. Not quite free between last two attacks	Severe, R. I. F.	With severe attacks	T. 99°	Deep tenderness R. I. F. Dilated cæcum
No. 11. A. E., 44, Female. 11. 10. 1914	Nine days	One attack	Severe, hypogastrium and R.I.F.	Severe	T. 98°	Marked deep tenderness R. I. F. Dilated cæcum
No. 12. C. P., 13, Male. 16. 12. 1914	Four months	Three attacks lasting one week	Severe, chiefly R. I. F.	None	T. 100° P. 124	Deep tenderness R.I.F. Small swelling appendix area
No. 13. M. A., 13, Female, 6. 4. 1915	Eighteen months	Three attacks lasting ten to twelve days. Last attack one month ago	Severe, R. I. F.	With each attack	T. 99° P. 102	Tenderness and slight rigidity R. I. F.

Condition at Operation	Operative Treatment	Convalescence	After-results
Movable cæcum. Jackson's membrane. Appendix long. No sign of inflammation	Appendicectomy	Temp. normal next day. Immediate cessation of all symptoms	Quite well for two months. Since then one or two slight attacks of pain
Appendix free. Long mesentery to cæcum and ascending colon. Jackson's membrane	Appendicectomy. Division of Jackson's membrane	Temp. normal next day. Immediate cessation of all symptoms	Remained free from all symptoms
Appendix normal. Cæcum movable. Long mesentery. Jackson's membrane. Lane's kink. Kidney abnormally mobile	Appendicectomy. Division of membrane	Uneventful. Pain ceased after operation	Case lost sight of
Retrocæcal normal appendix. Cæcum large. Movable mesentery. Transverse colon prolapsed. Jackson's membrane	Appendicectomy. Division of membrane	Immediate cessation of pain	Remained free from symptoms three months. Since then occasional slight attacks of pain in R. I. F., lasting few days
Appendix normal but covered by Jackson's membrane. Cæcum movable. Long mesentery. Well-marked Jackson's membrane	Appendicectomy. Division of membrane	Temperature normal next day. Pain ceased	Case lost sight of, but continued to have slight pain until eight months after operation
Normal appendix outer side of cæcum. Movable cæcum. Jackson's membrane	Appendicectomy	Temperature normal next day. Uneventful	Remained well since operation
Appendix bound down by membrane. Long, movable, and dilated cæcum. Jackson's membrane. Kidney slightly movable	Appendicectomy. Division of membrane	Temperature normal next day. Rapid cessation of pain	Well for six weeks, since then one or two slight attacks of pain. Somewhat relieved by belt
Well-marked visceroptosis—cæcum, ascending colon, and transverse colon easily withdrawn from wound. Jackson's membrane. Appendix healthy, but one or two membranous adhesions	Appendicectomy. Membrane divided	Uneventful	Complete recovery. No recurrence of pain
Appendix appeared normal. Marked visceroptosis. Long mesentery to cæcum. Jackson's membrane. Movable kidney	Appendicectomy. Division of membrane	Temperature normal next day. Rapid recovery	Remained quite well four months. Since then one or two slight attacks. Not relieved by belt
Small normal appendix. Large movable cæcum. Jackson's membrane. Movable kidney. Retroverted uterus	Appendicectomy. Division of membrane	Uneventful	Case lost sight of
Appendix healthy. Cæcum dilated, freely movable. Jackson's membrane. Movable kidney	Appendicectomy. Division of membrane	Rapid cessation of pain	Well for four months after operation. Since then four slight attacks of pain
Appendix healthy, adherent by membrane to outer side of cæcum. Cæcum very movable. Jackson's membrane. Marked Lane's kink	Appendicectomy. Division of membranes	Temperature normal next day. Uninterrupted recovery	Perfectly well for one month. Since then several attacks. Relieved in part by liquid paraffin
Appendix long, otherwise normal. Cæcum and ascending colon freely movable. Definite mesentery. Well-marked Jackson's membrane	Appendicectomy. Division of membrane	Uneventful	Free from symptoms since operation

Chronic Appendicitis.—It is to this type of the disease that most attention has been directed. Scattered throughout recent medical literature are a number of papers describing conditions for which an appendicectomy has been performed with but little relief, and a variety of causes have been described as giving rise to the recurrence of the symptoms. It is important, however, to remember that chronic appendicitis may be closely simulated by other lesions, of which only ureteric calculus and chronic salpingitis need be mentioned. It is essential to remember this, for it has been my experience that visceroptosis is so common in women that if it be found at operation it may be regarded as the cause of symptoms due in reality to one of these other lesions which has been overlooked.

In this series there were 16 cases which presented the symptoms of chronic appendicitis. Of these, 13 were females, a proportion very similar to that found in the cases of the last group. The average age was considerably higher, being in this series twenty-eight and a half years, the oldest patient, a male, being fifty-two and the youngest, also a male, seventeen. The number of attacks was often large, and in many cases the trouble had persisted for five or more years; in one case for twenty-five years.

In a typical case there would be a history of attacks of pain extending over three or four years. Occasionally the first attack was the most severe, and had kept the patient confined to bed for nine or ten days. After this there would be frequent attacks, at intervals of perhaps only a few weeks, the attacks themselves only lasting for a few days. In other cases the symptoms would commence with slight attacks, which had gradually increased in severity as the disease had progressed. In either case the attacks were often so frequent that there was an interval of only a few days between them, so that the symptoms might be nearly continuous; or if there were definite attacks at longer intervals, a certain amount of pain would persist between them. In some cases where the pain was stated to be constant, the patient would remark that it was so severe as to entirely disable her, and that this severe pain was present while the examination was being made, although she presented no evidence of any discomfort. On enquiry it was generally noticeable that, although the patient had had so many attacks and had perhaps been confined to bed for each, yet in not one of them was she regarded as being seriously ill. In fact it was most common to find that in the majority of the attacks the patient had only remained in bed for a few days. She would state that during them the pain would be severe, would most frequently start in the right iliac fossa, and would be limited to that area during the course of the attack. Vomiting was often a very marked feature, and caused little or no relief to the pain. The presence or absence of pyrexia had not as a rule been noted, but in those cases where the patient was cognizant of such observations, it was generally found that the temperature had not been raised. On questioning, a history of the presence of other symptoms could often be elicited. Headache was often present with 'biliousness,' consisting of an inability to take food, or discomfort after feeding. Occasionally an attack would be associated with frequency of micturition and dysuria, and nearly always there was constipation. On examination, it was usually noticed, especially in the females, that the patient was of poor build, with a long narrow

waist and a narrow costal angle. The muscular development was in some, but not in all, cases poor. There would be definite localized tenderness deep in the right iliac fossa, but no superficial tenderness. The cæcum could occasionally be felt and there was always well-marked gurgling over it. Not infrequently the right kidney was easily palpable. Some of the women had prolapse of the uterus. In this type of case there was no evidence of any change in the complexion, the sweat glands, or in the hair.

At operation, the findings would be almost identical with those described in the last group. There was a freely movable and large cæcum having a definite mesentery in its greater part. Over its outer wall was the very distinctive Jackson's membrane, but the fibrous accessory membrane on the under surface of the mesentery close to the terminal ileum was more frequent, it being present to a marked degree in 6 of the 16 cases. Mobility of the kidney was as a rule easily apparent through the incision.

The operative procedures consisted of removal of the appendix, division of the Lane's kink with suturing of the resulting bare area, and division of any portions of the Jackson's membrane which appeared to give rise to kinking of the cæcum. As in the cases resembling acute appendicitis, it was found that not infrequently the operation was not followed by permanent relief. It is true that some of them were absolutely cured. Five have had no return of their symptoms, and the vomiting and the pain have entirely ceased. Of the remaining 11 cases, 3 have been lost sight of. The remaining 8 have only showed slight improvement, or none at all, from the operative measures; of these, 5 remained perfectly free from symptoms for a period varying from three to five months, but after that time the symptoms gradually recurred until the condition was as bad as before operation; the remaining 3 showed no relief at all, the symptoms being as marked a week to a fortnight after operation as before. In all these cases a careful investigation of the Fallopian tubes and ovaries had been made at operation, and thus there arises no question that the symptoms were in any way due to lesions of these organs. In none of them was there any evidence of a ureteric calculus. In those cases which showed a return of symptoms an abdominal belt and liquid paraffin were ordered, which often gave marked or complete relief.

ILLUSTRATIVE CASES.

Case 1.—W. S., female, age 33, married, one child age 6. Since the age of eight years has suffered from many attacks of abdominal pain which used to double her up, and which she was told were due to colic. Eight years ago there was a severe attack of pain which was localized to the right iliac fossa. There was no vomiting, but much diarrhœa. For this she was kept in bed two weeks. Afterwards there were frequent small attacks which kept her in bed for one or two days. Three years ago there was a second severe attack which persisted for one month, during which there was much vomiting and dysuria. In May, 1914, there was a third attack which lasted for two weeks. Between the attacks there was often slight indigestion. For four years she has worn a ring pessary.

On examination, Sept. 22, 1914, she was found to be thin and poorly developed, with a flabby abdomen showing some separation of the recti and a narrow subcostal angle. There was deep tenderness in the appendix area and definite splashing over the stomach and cæcum. The right kidney was easily palpable.

At operation, the appendix was found free. The cæcum showed a long mesen-

tery and was dilated. There was a well-marked Jackson's membrane, and the right kidney was abnormally mobile. The appendix was removed, and the Jackson's membrane ligatured and divided. She remained quite well for three months after operation, when she had another attack associated with vomiting. An abdominal belt and liquid paraffin were ordered. On March 25, 1915, she stated she was quite free from all symptoms when wearing the belt; but if this was omitted the pain tended to recur.

Case 2.—B. B., female, age 18. Was admitted to hospital May 31, 1914. Two years before, she had an attack of severe pain in the right iliac fossa for which she laid up one week. Since this there have been three other attacks, the last occurring two and a half weeks ago. Each attack lasted four or five days, and consisted of severe pain in the right iliac fossa associated with vomiting. There was no pyrexia during the attacks. Between them there was a certain amount of discomfort after meals.

TABLE II.—**CASES OF VISCEROPTOSI**

NAME, AGE, SEX, DATE	LENGTH OF ILLNESS	PERIODICITY OF SYMPTOMS	PAIN	VOMITING	PYREXIA	CONSTIPATION
No. 1. A. S., 30, Female 16. 2. 1913	Two years	Severe attack at onset lasting ten days. Since then pain on and off at short intervals. Second severe attack six weeks ago	Always R.I.F.	In both severe attacks. No relief	No history	Marked for seve years
No. 2. W. R., 35, Male 22. 7. 1913	Three months	Two attacks three months and three weeks ago. Slight pain between	Started at umbilicus. Passed to R.I.F.	In first attack. No relief	T. 99° in last attack	Not marked
No. 3. C. M., 52, Male 10. 8. 1913	Ten years	Two severe attacks seven and three months ago. Constant slight symptoms between	R.I.F. in severe attacks. Epigastrium in intervals. Increased by food	In acute attacks only	Nil	Nil
No. 4. K. W., 17, Male 6. 10. 1913	Two years	Constant discomfort. Two severe attacks five and three weeks ago	Severe R.I.F. in the attacks. Discomfort R.I.F. in intervals	In acute attacks	Nil	Marked since o set
No. 5. E. S., 23, Female 12. 1. 1914	Four weeks	Severe attack at onset, lasting four days. Frequent attacks. Slight pain since	Localized to R.I.F.	Nil	Nil	Nil
No. 6. K. F., 37, Female 2. 2. 1914	Three years	Multiple attacks, lasting one to two days, at short intervals	Localized R.I.F. Severe in attacks. Slight at intervals.	Nil	T. 99°	For many year
No. 7. F. McG. 24, Female 14. 2. 1914	Eighteen months	Several attacks, lasting two to three days	Lower abdomen, passing to R.I.F.	Nil	Nil	Always been co stipated

On examination, the temperature was normal, the abdominal muscles were well developed, but the abdomen was long and narrow, with a small subcostal angle. There was definite tenderness in the right iliac fossa, and definite gurgling over the cæcum. The right kidney was not palpable.

On June 3, 1914, an operation was performed. The cæcum was found to be large and movable, with a well-defined mesentery. The appendix was long and not adherent. There was a well-marked Jackson's membrane, and the kidney was very slightly mobile. The appendix was removed and portions of the Jackson's membrane divided. The wound healed by primary union, and convalescence was rapid.

On October 22, 1914, she stated that she had remained perfectly well until three weeks ago, when there was a return of the attacks of pain and vomiting. Nothing abnormal could be determined on abdominal examination. A belt and liquid paraffin were ordered, which gave considerable but not complete relief from the symptoms.

RESEMBLING CHRONIC APPENDICITIS.

Physical Signs	Condition at Operation	Operative Treatment	After-Results
Long narrow abdomen. Gurgling cæcum. Tenderness R.I.F.	Cæcum freely movable, definite mesentery. Well-marked Jackson's membrane, involving appendix	Appendicectomy. Division of membrane	Case lost sight of
Muscular development fair. Deep tenderness, R.I.F. No swelling	Movable cæcum. Jackson's membrane. Few membranous adhesions to appendix, otherwise normal. Well-marked Lane's kink	Appendicectomy. Division of bands and adhesions	Remained quite well after operation
Well developed. Gurgling cæcum. Tenderness R.I.F.	Appendix small, fibrous, bound to cæcum by membrane. Cæcum movable with mesentery. Jackson's membrane. Well-marked Lane's kink	Appendicectomy. Division of membranes and bands	Quite well for three months. After this some return of pain and discomfort
Well developed. Some dilatation of cæcum. Tenderness R.I.F.	Cæcum freely movable. Well-marked Jackson's membrane. Appendix retrocæcal beneath membrane	Appendicectomy.	Quite well since operation
Long narrow abdomen. Dilated cæcum. Tenderness R.I.F. Movable right kidney	Cæcum and colon very mobile. Mesentery to cæcum and ascending colon. Marked Lane's kink. Appendix normal	Appendicectomy. Division of bands and membrane	Case lost sight of
Narrow abdomen and subcostal angle. Dilated cæcum. Tenderness R.I.F.	Movable cæcum. Marked Jackson's membrane over cæcum and ascending colon. Appendix normal	Appendicectomy. Division of membrane	Little or no relief from operation. Abdominal belt and liquid paraffin gave some relief
Small, ill-developed woman. Narrow abdomen. Dilated cæcum. Tenderness R.I.F.	Large movable cæcum. Well-marked Jackson's membrane. Appendix normal. Ovarian cyst, right, three inches diameter	Ovariotomy. Appendicectomy	Quite well since operation. Is now nursing at the front

Continued on next page

TABLE II, continued.—**CASES OF VISCEROPTOSIS**

NAME, AGE, SEX, DATE	LENGTH OF ILLNESS	PERIODICITY OF SYMPTOMS	PAIN	VOMITING	PYREXIA	CONSTIPATION
No. 8. L. L., 30, Female, 19. 5. 1914	Five years	Severe attack at onset, fourteen days. Since then frequent attacks of slight pain. Never free for more than one week	Always R.I.F.	Nil	99·5°	Nil
No. 9. B. B., 18, Female 13. 5. 1914	Two years	Four attacks, lasting four to five days. Slight discomfort after meals between	Severe R.I.F.	With acute attacks	Nil	Slight
No. 10. M. J., 31, Female 2. 6. 1914	Five years	Severe attack at onset. Slight pain R. I. F. ever since. Three more severe attacks	Always R.I.F. Increased during micturition	In acute attacks	Nil	Nil
No. 11. C. Da. C. 21, Female 23. 8. 1914	Two years	Attacks of pain every one to two weeks, lasting two to three days. Often in bed, as condition was diagnosed as appendicitis	R.I.F., occasionally, starting in epigastrium	Occasionally in acute attacks	Nil	Marked four years
No. 12. R. C., 24, Female 24. 8. 1914	Ten months	Attacks lasting one to two hours every day. No work. Four months, in bed two weeks	Always R.I.F.	Nil	Nil	Always marked
No. 13. W. S., 33, Female 22. 9. 1914	Twenty-five years	Many short attacks, lasting one day. Diagnosed in childhood as colic. Three severe attacks, lasting two weeks	Always R.I.F. Occasionally epigastrium	Frequently	Nil	Nil. Frequent attacks of diarrhœa
No. 14. F. M., 23, Female 16. 10. 1914	Eight weeks	Four attacks, lasting one to two days. Not completely free between attacks	Always R.I.F.	In the attacks	T. 99°	Nil
No. 15. F. H., 25, Female 18. 11. 1914	One year	Three severe attacks, lasting four to fourteen days. A slight pain between attacks	Always R.I.F.	Nil	Nil	Marked for eighteen months
No. 16. M. P., 31, Female 14. 1. 1915	Two years	Four severe attacks, lasting one to two weeks. Multiple small attacks between, lasting one to two days	Lower abdomen and R.I.F.	With acute attacks	Nil	Nil

RESEMBLING CHRONIC APPENDICITIS.

PHYSICAL SIGNS	CONDITION AT OPERATION	OPERATIVE TREATMENT	AFTER-RESULTS
Long narrow abdomen. Poor muscular development. Tenderness R.I.F. Slight gurgling	Movable cæcum. Jackson's membrane. Marked Lane's kink. Appendix normal	Appendicectomy. Division of band and membrane	Remained free from symptoms for five months. Since then return of pain and discomfort R.I.F.
Muscles well-developed. Long narrow abdomen. Tenderness R.I.F. Dilated cæcum	Cæcum large and movable with mesentery. Well-marked Jackson's membrane. Right kidney slightly mobile. Appendix normal	Appendicectomy. Division of membrane	Remained well for four months. Since then return of attacks of pain. Some relief from abdominal belt and liquid paraffin
Long narrow abdomen. Distended cæcum. Tenderness R.I.F. Movable right kidney	General visceroptosis. Dilated movable cæcum. Jackson's membrane. Adhesions between transverse and ascending colon. Well-marked Lane's kink. Appendix bound down by membrane	Appendicectomy. Division of bands and membrane	No relief from operation. Some relief from abdominal belt
Ill-developed. Narrow abdomen. Tenderness R.I.F. Some dilatation of cæcum	Appendix normal. Dilated movable cæcum. Marked Jackson's membrane	Appendicectomy. Division of membrane	Case lost sight of
Tenderness R.I.F. Dilated cæcum. Muscular development poor	Appendix normal. Cæcum large, very movable. Jackson's membrane	Appendicectomy. Membrane divided	Much improved for two months. Then return of symptoms. Belt ordered. Slight improvement
Narrow abdomen, with poor muscular development and separation of recti. Much dilatation of stomach and cæcum. Right kidney movable. Tenderness R.I.F. Prolapse of uterus	General visceroptosis. Dilated movable cæcum. Jackson's membrane. Appendix normal	Appendicectomy. Membrane divided	Well for two months. Then recurrence of symptoms. Abdominal belt gave considerable relief
Well developed. Muscular. Dilated cæcum. Tenderness R.I.F.	Very movable dilated cæcum. Jackson's membrane. Appendix normal	Appendicectomy. Division of membrane	Quite well since operation
Narrow abdomen. Good muscles. Some dilatation of cæcum. Tenderness R.I.F.	Cæcum dilated and movable. Well-marked Jackson's membrane. Appendix bound down by membrane to outer side of cæcum. Well-marked Lane's kink	Appendicectomy. Division of membrane	Remained well for four months. Since then has had slight return of pain in R.I.F. Relieved by belt
Narrow abdomen. Both kidneys palpable. Tenderness and gurgling R.I.F.	General visceroptosis. Cæcum and ascending colon movable, with free mesentery. Marked Lane's kink. Jackson's membrane. Appendix bound down by membrane.	Appendicectomy. Division of membrane and band	Quite well since operation

Diagnosis.—It will be seen from the above description that there is a superficial resemblance of these cases to appendicitis. There may, however, be well-marked points of distinction. There is often a history of previous attacks, all of which have been slight and have been repeated at short intervals. In the acute cases there is but slight pyrexia, and the patient shows but little evidence of severe illness. If the condition has existed for some days, there are no symptoms suggestive of a local abscess such as might be expected in a case of appendicitis of a similar duration. There is, moreover, but little rigidity. However, if the attack has only lasted a few days diagnosis may be impossible, for all are conversant with those cases where the symptoms are very slight and yet a gangrenous appendix is found at operation. Hence in cases of doubt it is always better to operate.

In chronic cases the differential diagnosis is more readily made. The number of attacks is larger, and although they have occurred at frequent intervals over a considerable number of years, the condition has never been severe. The majority of the attacks have only persisted for a few days, and often their severity is not progressive. In cases of appendicitis one would expect one at least of the attacks to be much more severe, and to be associated with well-marked evidences of inflammation. In the attacks the pain is very definitely limited to the right iliac fossa, whereas in cases of acute appendicitis it more commonly starts in the region of the umbilicus and passes from there to the iliac fossa. Another factor is the frequency with which the symptoms persist between individual attacks, and the patient often complains of severe pain which is present every day, although clinical investigation shows no evidence of deterioration of the general health or indeed of the presence of such pain. The symptoms differ considerably from those described as appendix dyspepsia, in that the dyspeptic symptoms are a minor factor, the patient chiefly complaining of the trouble in the iliac fossa. On examination, there is no pyrexia, no superficial tenderness, and no rigidity, but there is often the evidence of visceroptosis in the build of the patient, evidence of a dilated cæcum, and not infrequently some mobility of the kidney.

CASES RESEMBLING GASTRIC ULCER.

There were 27 cases in this group, but 5 of them must be considered apart from the others. These five patients showed well-marked evidence of visceroptosis, but in addition had either a gastric or duodenal ulcer. The remaining 22 showed visceroptosis alone. It is doubtful whether the former group should be considered with the cases of visceroptosis; but it is important to recognize that such a combination can occur; the symptoms tend to resemble those of the patients with visceroptosis rather than those of a case of ulcer alone, and hence it may be difficult or impossible to say that a case which suggests the presence of visceroptosis may not also have an ulcer of the stomach or duodenum.

The 5 cases showing the presence of a gastric or duodenal ulcer consisted of 4 males and 1 female, and the average age was forty years. In addition to the ulcer they all showed clearly one or more of the pathological lesions characteristic of visceroptosis. Thus in every case there was a large and

movable cæcum with a Jackson's membrane, and in others a Lane's kink was present. The relative frequency of these changes, especially the Lane's kink, is of interest. The writings of Lane and Jordan tend to prove that a duodenal or a gastric ulcer is frequently secondary to kinking of the terminal ileum. In all my cases of gastric or duodenal ulcer the cæcum and appendix have invariably been examined. Now in the period of time covered by the present series I operated upon 83 cases of gastric ulcer; but as already stated, in only 4 of them was there a definite kink of the terminal ileum. In the same period there were 38 cases of duodenal ulcer, and only 1 of them showed the presence of this condition. These figures would seem to show that the combination is a rare coincidence, and that it is far more frequent to find an ulcer without visceroptosis than with it.

The remaining 22 cases are of greater importance, for they are of the type which has been in the past so frequently operated upon in the belief that a gastric ulcer was present; in the earlier days of gastro-enterostomy the operation was often performed for this condition, either because the stomach was dilated, because there was spasm of the pylorus, or because it was believed that such an operation would bring about the cure of the attacks of hæmatemesis. That the operation failed to bring relief has been shown over and over again, and in my own experience, as I hope to show in a later paper, it has no effect in preventing the recurrence of hæmatemesis if uncombined with other methods. It is therefore important, especially as these cases are so frequent, that when the laparotomy is performed the true pathology of the condition be recognized, and that a useless operation such as gastro-enterostomy should not be carried out.

These 22 cases consisted of 18 females and 4 males, a proportion almost the same as in the cases resembling appendicitis. The average age was thirty-six, the oldest patient being fifty-eight and the youngest twenty-five. The symptoms had as a rule extended over many years, most commonly five or six, but occasionally for as many as twenty. It would sometimes happen that there would be an attack at the commencement of the trouble which would last for one or several weeks. This would be followed by a period of freedom of four or five years, at the end of which time the symptoms would recur. Much more frequently, however, it would be found that the attacks occurred at relatively short intervals. There might be only a few days, or perhaps three or four weeks, of freedom between any two attacks. In several cases the patient stated that the symptoms were almost continuous; and careful investigation would generally show that even in the cases with periodic attacks the patients were not completely free during the intervals; they would still continue to have slight discomfort after food, together with flatulence. The attacks themselves did not as a rule last very long. Very frequently they only persisted for two or three days, but occasionally this period would be prolonged for one or two months, and as a general rule, the longer the pain the longer the intervals of freedom. In the attacks themselves there would be pain in the epigastrium, which might be localized to this area, or radiate from there to the right hypochondrium, between the shoulders, or down to the lower abdomen. This pain would usually be described as severe or acute. It might come on immediately after food, and was then not infrequently

associated with flatulence. In other cases it would not occur until one or two hours after the meal, and would thus more clearly resemble the pain of gastric ulcer. Although the pain would appear after the food, it often did not entirely disappear by the next meal, and there would be a feeling of slight discomfort or pain persisting throughout the whole day. Sometimes relief was obtained by the administration of sodium bicarbonate, and another very suggestive fact was that the recumbent position would at times afford relief.

It will be noticed that in only one case was the pain relieved by food, and here a duodenal ulcer was also present.

Vomiting was a common symptom. The majority of patients would state that it was present with every attack, and in some indeed it would occur when the other symptoms were absent. In such circumstances the patient would vomit several times a day, the vomited material being small in amount and sometimes consisting of only frothy mucus. Generally it would only partly relieve the pain, and often there would be no relief at all: it is this characteristic especially which will often give rise to the suspicion that no ulcer is present.

Hæmatemesis was not uncommonly seen, thus emphasizing the fact that the presence of this symptom is by no means to be regarded as evidence of the presence of an ulcer. Of these 22 cases it occurred in 11, a percentage which in my experience is identical with what occurs in chronic gastric ulcer.[22] The loss of blood was often severe, and this in the more elderly as well as in the young patients. Thus, in two of them, respectively fifty-six and fifty-eight years of age, there had been severe losses of blood. As to the cause of the bleeding, but little evidence is to be obtained from this series. None was operated upon on account of the hæmatemesis alone. In no case was an exploratory incision made into the stomach, and in no case did death occur. Thus there was no evidence, such as may be obtained in cases of acute hæmatemesis, to show whether the loss is due to a gastrostaxis as believed by Hale White,[10] or to the presence of multiple small ulcers as claimed by Bolton.[3] My own experience, obtained from a series of cases of acute hæmatemesis, is strongly in favour of Bolton's view, and analogy with this condition would lead one to suspect that in cases of visceroptosis also small ulcers or erosions may be present in the gastric mucosa.

The appetite is very frequently affected. During the attack the patient would frequently state that there was a loss of all desire for food, and it was clearly to be distinguished that the alteration was a loss of desire, and not simply the fear of taking food owing to the pain it produced. If the attacks were frequent there would be, with the loss of appetite, a distinct loss of weight.

The test meal was taken in 15 of the 22 cases, and it will be seen from the table that in 8 of them it showed either a mere trace or no free hydrochloric acid, the total acidity being correspondingly diminished. On the other hand, 6 had a test meal within the limits of normal; and in 1—an unusual case—the free hydrochloric acid was exceptionally high, being 0·2 per cent, a percentage even above the average of duodenal ulceration.

On physical examination, these patients not infrequently present a long,

narrow abdomen, with a contracted lower thorax and a narrow subcostal angle, the females especially appearing to have a pelvis too big for the body. In addition, it is often easy to distinguish that the stomach and cæcum are distended. There may be distinct splashing and gurgling when the viscera are palpated, and one or both kidneys may be found to be abnormally mobile. In one or two cases it was possible to make out that the liver was at a lower level than normal.

At operation, there was no trace of an ulcer in the stomach or duodenum. The stomach was considerably prolapsed and U-shaped, and the walls of this viscus often showed marked areas of local spasm when handled, a similar spasmodic contraction being also commonly seen at the pylorus. The cæcum showed the presence of a mesentery and was freely movable, so that it could not infrequently be withdrawn through the upper abdominal incision. In such cases it showed a well-marked Jackson's membrane. The kidney could be felt moving freely in the loin. A well-marked Lane's kink was commonly present. The operative procedures consisted in dividing any excessive bands or adhesions, and if the appendix was bound down by the Jackson's membrane, it was removed. In one case only, where the stomach appeared to be hypertrophied and where there was an excessive pyloric spasm, the pylorus was occluded and a posterior gastro-enterostomy performed. In two cases the right kidney was exceedingly movable, and nephrorrhaphy was carried out.

The results of operative treatment could not be considered satisfactory as a whole. Nearly all the cases showed very marked relief for two to six months, but after that time the symptoms gradually returned. In one case the patient stated two years later that she felt very well and was much better than before operation, and this in spite of the fact that the abdomen had been closed, when the true nature of the condition had been discovered, without any operative measures having been undertaken. On cross-examination, however, she confessed to one or two small attacks, the last of which had occurred six months previously. In other cases a certain amount of relief had been afforded by the use of a belt.

ILLUSTRATIVE CASES.

Case 1.—E. S., female, age 33. For ten years has suffered from slight attacks of indigestion. For the last five they have been severe and almost constant, so that she would only be free from the trouble for one or two days occasionally. During this time the pain was situated in the epigastrium, and was present for the greater part of the day. It was always increased by taking food, being most marked one hour after the meal. One year ago she had a more severe attack, during which she vomited two or three times a day. Vomiting caused a certain amount of relief, but never caused the pain to disappear entirely. She was admitted to a cottage hospital with a diagnosis of gastric ulcer, and was very strictly dieted and medically treated. This attack lasted two months, and under the medical treatment gradually improved. Six months ago the severe symptoms again returned, and continued until her admission to hospital on April 27, 1914.

On examination, it was found that there was local tenderness over the right rectus, and a certain amount of gurgling in the area of the cæcum, but neither kidney could be felt. The test meal showed free hydrochloric acid 0·06 per cent and a total acidity of 41.

On April 29 the abdomen was opened by an upper right rectus incision, the muscle being displaced outwards. The stomach was found to be dilated and pro-

lapsed, reaching well below the umbilicus. Its walls showed areas of local spasm. The duodenum was movable, and there were adhesions between it and the liver. There was no evidence of ulceration of the stomach or duodenum or of the presence of gall-stones. The cæcum was long and lax, and was easily pulled out through the wound in the upper abdomen. There was a well-marked Jackson's membrane on its surface. The appendix was normal. The terminal portion of the ileum was firmly bound down by a stout accessory membrane on the under surface of the mesentery (Lane's kink). The accessory membranes were divided and the abdomen was closed. The patient remained perfectly well and free from all symptoms until October, 1914. For the next four months she had attacks of pain lasting for about one week, remaining free for intervals of three or four days between each. During the attacks there was pain—increased by taking any food—and vomiting, which somewhat relieved the pain. She was ordered an abdominal belt. She was last seen on May 20, 1915. She then stated that she had a certain amount of relief from the belt ; but the pain had returned together with vomiting, and had persisted for the last six weeks.

Case 2.—F. C., female, age 28, married. One child, age 6 ; two miscarriages. The patient was quite well until one year before operation, since when she has had attacks of pain every two or three weeks. Each lasts one to seven days, but even between these there is a certain amount of discomfort after food, and flatulence. During the attacks there is more severe pain in the epigastrium, which is increased by taking food, and is associated with vomiting and giddiness. The vomiting consists of bile-like fluid, and only in part relieves the pain. She has never had any hæmatemesis during the attacks.

TABLE III.—**VISCEROPTOSIS WITH GASTRIC**

NAME, AGE, SEX, DATE	LENGTH OF ILLNESS	PERIODICITY OF SYMPTOMS	PAIN	VOMITING	HÆMATEMESIS	APPETITE	TEST MEAL	PHYSICAL
No. 1. A. A., 29, Male. 25. 8. 1913	Ten years	Attacks four to five a year. Last two weeks	Epigastrium, two hours post cibum	Frequent. Relieves pain	Never	Good	—	Wasted, ness epigas
No. 2. C. B., 58, Male. 6. 7. 1913	Thirty-three years	Free since first attack until twelve months ago. Since then continuous	Epigastrium, one and a half hours p. c. Relieved by food. Flatulence	Yes. Relieves pain	No	Poor, losing weight	Free HCl 0·09 per cent. T. A. 50	Tender Stomach cæcum dil
No. 3. W. P., 43, Male. 26. 1. 1914	Eleven years	First attack six weeks. Free four years. Later attacks more frequent. Continuous last three months	Right hypogastrium to back, one to two hours p. c. Lasts one hour. Occasionally at night	Occasionally. Slightly relieves pain	Never	Very poor, wasting	Free HCl 0·15 per cent. T. A. 60	Tender righ gastrium. gurgling
No. 4. A. K., 40, Male. 26. 1. 1914	Two years	Attacks one to two weeks. Free intervals, two to three weeks	Epigastrium and lower abdomen, one and a half hours p. c. Relieved by food. Occasionally at night	Very rarely. No relief	Never. Melæna in most attacks	Good	Free HC 0·07 per cent. T. A. 4	Slight tend
No. 5. S. P., 30, Female. 16. 3. 1914	Ten years	Attacks half to three weeks. Free, two to three months	Epigastrium, few minutes p. c.	In attacks. Relieves pain	Two attacks. Severe	—	Free H 0·056 per cen T. A. 4	Epigastric ness. Dis of cæcum

On examination, the abdomen was seen to be long and narrow. There was gurgling and splashing over the cæcum and stomach, and the right kidney was freely movable. The test meal showed only a trace of free hydrochloric acid, with a total acidity of 45.

On May 27, 1914, the abdomen was opened by an upper right rectus incision, the muscle being displaced outwards. There was marked general visceroptosis, the liver being prolapsed and the stomach and cæcum dilated and freely movable. There was no sign of ulcer. The appendix was normal but rather long. There was a marked Lane's kink and Jackson's membrane. These latter were divided and the appendix was removed. The abdomen was then closed, and the right kidney fixed by a second incision in the loin.

There was an uninterrupted convalescence. On June 23 there was considerable improvement. She was able to take her food well, and there had been no recurrence of pain or vomiting. On August 11 she stated that there had been four attacks of pain, during each of which she had had vomiting. These had only lasted for a few days. She was ordered an abdominal belt. By September 25 she was feeling well, and there had been no recurrence of the symptoms. She has remained well since.

The details of the cases in this group are shown in *Tables III and IV*. *Table III* includes those cases which, in addition to the visceroptosis, presented ulceration of the stomach or duodenum, *Table IV* including those with no lesion other than visceroptosis.

GASTRIC OR DUODENAL ULCER.

PHYSICAL SIGNS	CONDITION AT OPERATION	TREATMENT	AFTER-RESULTS
Wasted, tenderness epigastrium	Gastric ulcer near pylorus. Movable cæcum. Jackson's membrane. Lane's kink	Ulcer embedded, posterior gastro-enterostomy. Appendicectomy. Kink divided	No return of symptoms since operation
Tenderness. Stomach and cæcum dilated	Ulcer, lesser curve. Visceroptosis. Dilated stomach. Lane's kink	Ulcer excised. Posterior gastro-enterostomy. Appendicectomy. Kink divided. Adhesions divided	Rapid recovery. Eighteen months later much better. Occasionally attacks of vomiting
Tender right hypogastrium. Cæcum gurgling	Adhesions — gall-bladder, stomach, liver. Ulcer—posterior surface, lesser curve. Jackson's membrane. Lane's kink. Appendix adhesions	Ulcer embedded. Posterior gastro-enterostomy. Kink divided	Rapid recovery. Remained quite well one year after operation
Slight tenderness	Ulcer, first part of duodenum. Lane's kink. Movable cæcum	Excision of ulcer. Posterior gastro-enterostomy. Kink divided	Complete relief three months. One year later occasional vomiting. Very little pain
Epigastric tenderness. Distention of cæcum	Old ulcer, lesser curve. Marked visceroptosis. Distended cæcum. Lane's kink	Ulcer excised. Posterior gastro-enterostomy. Kink divided	Rapid recovery. Ten months later perfect health

Name, Age, Sex, Date	Length of Illness	Periodicity of Symptoms	Pain	Vomiting	Hæmatemesis	Appetite	Test Meal
No. 1. G. C., 33, Female. 29. 5. 1909	Three years	Attacks frequent intervals, lasting one to two days	One hour p. c. in epigastrium	Frequent. Does not relieve pain	Never	Poor in attacks	—
No. 2. C. O., 58, Female. 20. 1. 1913	Eight years	Attacks for two years every two to three months, lasting one week	Shortly p. c. in epigastrium, lasts half an hour	Occasional. Relieves pain	Severe eight and two years ago	Bad	—
No. 3. E. B., 33, Female. 24. 11. 1913	Six years	Every two weeks. Attacks last one week. Worse in winter	Epigastrium, immediately p. c., with flatulence	Frequently, often several times a day. No relief	Never	Bad in attacks	—
No. 4. W. H. 25, Male. 11. 10. 1913	Two years	Lasting three to four days, every two months first year; constant second year	Epigastrium, one and a half hours p. c. Relieved by food. Flatulence	Frequent. Relieves pain	Slight, coffee grounds	Good, but loss one and half stone weight	Free HCl 0·1 per cent. T.A. 68
No. 5. E. G., 27, Female. 3. 2. 1914	Eleven months	Nearly continuous	Epigastrium, left hypogastrium half an hour p. c. Flatulence	Occasional. Does not relieve pain	One attack five months ago, severe	Fair	—
No. 6. E. P., 56, Female. 26. 2. 1914	Twenty-six years	Frequent attacks, every few weeks, lasting few days	Shortly p. c. in epigastrium. Acute	One to two hours p.c. Relieves pain	One attack ten years ago, severe	Bad	—
No. 7. O.H., 26, Female. 30. 3. 1914	Ten weeks	Three attacks. Last three to four days	Epigastrium, p.c. Severe	No vomiting	No	Good. Lost one stone weight	Free HCl 0·07 per cent. T.A. 47
No. 8. M.M., 58, Female. 23. 3. 1914	Four to five years	Attacks every six weeks. Last one to two days. More frequent six weeks	Epigastrium, lower abdomen. Severe	Frequent. Slightly relieves pain	Never	Good	Free HCl Absent. T.A. 41
No. 9. E. S., 33, Female. 27. 4. 1914	Ten years, worse five years	Almost constant. Greater severity every few months	Epigastrium, half an hour p.c.	Twice a day. Relieves pain	Never	Poor	Free HCl 0·06 per cent. T.A. 41
No. 10. F. B., 38, Female. 5. 5. 1914	Ten years, worse five years	Constant five years	Quarter of an hour p. c., epigastrium passing to back. Occasionally at night	Occasional. Always relieves pain	Never	Fair	Free HCl 0·2 per cent. T. A. 80
No. 11. F. G., 28, Female. 25. 5. 1914	One year	Every two to three weeks. Attacks lasting one to seven days	Immediately p. c. Occasionally at night. Epigastrium and back	In last six months only. Relieves pain	No	Good	Free HCl Trace. T. A. 45
No. 12. J. E., 35, Male. 18. 8. 1914	Twelve years	Almost continuous. Short intervals of freedom	Epigastrium, immediately p. c., lasting two hours. Not at night	Acid regurgitation only	No	Poor	Free HCl Trace. T. A. 55

PHYSICAL SIGNS	CONDITION AT OPERATION	TREATMENT	AFTER-RESULTS
Stomach dilated	General visceroptosis. Stomach dilated. Liver prolapsed. Kidney movable	Abdomen closed. Abdominal belt	11. 3. 1911. Feels very well. Much better than before operation. One or two small attacks, last six months ago
Wasted. Right kidney palpable	Stomach dilated. Movable cæcum. Jackson's membrane. Movable kidney	Appendix removed	Free from symptoms three months. Return of pain partly relieved by belt
Nil	General visceroptosis. Movable cæcum. Jackson's membrane. Kidney slightly movable	Nil	Much improved three months. Then return. Belt ordered —slight improvement
Tenderness epigastrium and R.I.F. Gurgling over cæcum	Stomach dilated. Lane's kink. Appendix adhesions	Kink divided. Appendicectomy	Free from symptoms two months, then slight return
Tenderness epigastrium. Liver and kidneys palpable	Visceroptosis. Pyloric spasm. Hypertrophied stomach. Kidneys very movable. Jackson's membrane	Pylorus occluded, posterior gastro-enterostomy	Six weeks after operation still pain and vomiting. Persisted seven months after operation. Little or no relief from belt
Tenderness epigastrium and R.I.F. Right kidney palpable	Visceroptosis. Jackson's membrane	Nil	No relief from operation
Tenderness epigastrium and R.I.F. Kidneys movable	Movable cæcum. Jackson's membrane. Lane's kink. Gastroptosis. Movable kidney	Appendicectomy. Kink divided. Nephrorrhapy	Quite free from symptoms for seven months. Then slight return for one week. Since then free
Stomach dilated. Gurgling over cæcum	Stomach dilated. General visceroptosis. Jackson's membrane	Nil	Slight relief
Tenderness right upper rectus. Right kidney palpable	General visceroptosis. Stomach dilated. Cæcum movable. Jackson's membrane. Lane's kink	Kink divided. Appendicectomy	Quite free six months. Then return pain and vomiting. Attacks last a week, with week interval
Deep tenderness epigastrium. Stomach dilated	No gastric or duodenal ulcer. General viceroptosis. Movable cæcum. Jackson's membrane. Appendix seven inches long	Appendicectomy	Some relief, but still has pain
Stomach and cæcum dilated	General visceroptosis. Stomach and cæcum very prolapsed. Jackson's membrane. Lane's kink. Right kidney movable	Kink and membrane divided. Appendicectomy. Nephrorrhaphy	Quite well three months. Then four slight attacks with vomiting. Well since
Tenderness epigastrium. Dilated cæcum	Prolapsed stomach. Movable cæcum. Jackson's membrane. Lane's kink	Kink divided. Appendicectomy	Five months after operation. Still pain. Worn a belt with no relief. Swedish exercises. No relief.

Continued on next page

NAME, AGE, SEX, DATE	LENGTH OF ILLNESS	PERIODICITY OF SYMPTOMS	PAIN	VOMITING	HEMATEMESIS	APPETITE	TEST ME	PHYSICAL
No. 13. R.G., 32, Female. 25. 7. 1914	Six years	Attack three months. Free four years. Since then three attacks one month	Epigastrium, immediately p. c.	Frequently. Slightly relieved	No	Poor in attacks	Free HC Nil. T. A. 1	Tenderness trium. G cæcum
No. 14. S. F., 30, Female. 25. 8. 1914	Twenty-three years	Attacks lasting two to three months. Intervals five to six weeks	Epigastric, severe. Immediately p. c., lasts half an hour	Very frequent. Slight relief	Frequent, small quantities	Poor	Free HC Absent. T. A. 38	Tenderness trium. ling cæcu pable righ
No. 15. D.W. 29, Female. 12. 10. 1914	Eleven months	Five attacks lasting one week	Severe epigastric. Immediately p.c., relieved by lying down and soda carbonate. Flatulence	Occasional. No relief	Two severe attacks	Good	Free HC Absent. T. A. 38	Nil
No. 16. S. S., 35, Female. 19. 10. 1914	Two years. Then acute appendicitis with appendicectomy	Attacks every two months lasting one week. Slight dyspepsia between	Acute. Shortly p.c., epigastrium, right shoulder	Frequent. No relief	No	—	Free HC Nil. T. A. 34	Liver eas pable,
No. 17. L. S., 38, Female. 21. 10. 1914	Six months	Nearly continuous	Half an hour p.c. Left hypochondrium, between shoulders, severe	Frequently. Slight relief	One attack, six months ago	Poor	—	Dilated Gurgli cæcum
No. 18. A.G., 41, Male. 2. 11. 1914	Ten years	Frequent attacks, every two to three days. Two to three months intervals	Epigastrium, dull. Worse p. c. Flatulence	Yes. Does not relieve pain	Never	Bad, wasting	Free HCl 0·08 per cent T. A. 46	Gurgling Tenderr abdome
No. 19. R.P., 30, Female. 2. 2. 1915	Four years	Attacks, four years. Lasted one week. Then free three years. Since then attacks lasting four days with few days interval	Epigastrium, sharp, to back, immediately p.c.	Frequently. Relieves pain	Severe eight months ago	Poor	—	Narrow Gurglin
No. 20. P.A., 50, Male. 25. 1. 1915	Two years	Attacks two to three weeks. Free three to four months	Epigastrium, half an hour p.c.	Occasional. Relieves pain	Small attacks	Poor, wasting	Free HCl 0·15 per cent. T. A. 55	Gurgling and cæ
No. 21. L.K., 38, Female. 15. 2. 1915	Constant indigestion nineteen years. Attacks five years	In five years, four attacks about four weeks	Epigastrium to back, half an hour p.c. Lasted one hour	No.	Severe in each attack	Bad in attacks	Free HCl 0·13 per cent. T. A. 52	Tenderr ling ov
No. 22. M.A., 36, Female. 21. 5. 1915	Five years	Six attacks, one week to three months. Free between	Epigastrium, immediately to one hour p. c. Lasts one to two hours. Occasionally at night	Each attack. No relief.	Frequent small attacks	—	Free HCl Absent. T. A. 25	Narrow abdon kidney

Physical Signs	Condition at Operation	Treatment	After-results
Tenderness epigastrium. Gurgling cæcum	Stomach prolapsed. Cæcum very movable. Jackson's membrane	Appendicectomy. Membrane divided	No relief
Tenderness epigastrium. Gurgling cæcum. Palpable right kidney	General visceroptosis. Stomach prolapsed. Freely movable duodenum. Movable cæcum. Jackson's membrane	Membrane divided	Five months after operation. Still attacks, pain and vomiting. No relief from belt. In attacks lives on milk diet
Nil	Stomach prolapsed. General visceroptosis. Movable pancreas. Lane's kink. Jackson's membrane	Membranes divided. Appendicectomy	Two months after operation. No return of symptoms
Liver easily palpable, enlarged	General visceroptosis. Liver prolapsed. Large Riedel's lobe	Nil	Pain continued four months after operation. Still present but better than before operation
Dilated stomach. Gurgling over cæcum	General visceroptosis. Appendix adherent. Lane's kink. Movable cæcum. Jackson's membrane	Kinks divided. Appendicectomy	Quite well for six months. Then return of pain passing to lower abdomen
Gurgling cæcum. Tenderness upper abdomen	General visceroptosis. Movable cæcum. Jackson's membrane	Nil	Free for three months; since then slight return
Narrow abdomen. Gurgling cæcum	Movable cæcum. Jackson's membrane. Lane's kink	Kink divided. Appendicectomy	Little or no relief
Gurgling stomach and cæcum	General visceroptosis. Cæcum movable. Jackson's membrane	Nil	Well for three weeks. After this slight return of pain
Tenderness. Gurgling over cæcum	General visceroptosis. Movable cæcum. Jackson's membrane. Lane's kink	Nil	Well for six weeks. Slight return since
Narrow retracted abdomen. Right kidney palpable	General visceroptosis. Stomach, cæcum, kidney, very movable. Jackson's membrane.	Membrane divided	—

Diagnosis.—It will be seen from the above descriptions that the resemblance to gastric ulcer is only superficial, and were it not for the fact that some cases present an ulcer in addition to the visceroptosis, there would be but little difficulty after one or two cases had been met with in deciding that they were suffering from visceroptosis. Unfortunately, if an ulcer occurs in a patient who is already a subject of visceroptosis, the latter lesion may so change the usual symptoms of the ulcer that a correct diagnosis becomes difficult. For this reason it is wise to perform an exploratory laparotomy in cases of doubt, even if visceroptosis be alone present some relief may be gained by dividing the abnormal bands and adhesions, especially if an abdominal belt be afterwards ordered.

The uncomplicated cases differ from those of true gastric ulcer[22] in that the attacks are not so well defined. They are as a rule much shorter, and occur at more frequent intervals. Even in the intervals there will not be that complete relief which is so marked a feature when an ulcer is present, a certain amount of pain and flatulence still persisting. The patients are much more commonly young or middle-aged women. The pain has not nearly so well defined a relationship to food. It will be much more constant during the attacks although it may be severe. If increased by food, the increase is often noted at a much shorter interval after the food. Vomiting is very frequent, often occurring two or three times a day during the attacks. It does not relieve the pain as generally happens with an ulcer, and it is often associated with headache and giddiness. Hæmatemesis is equally common with either condition, and may often be large in quantity. There is no doubt that in the past many cases were diagnosed as gastric ulcer owing to the presence of this symptom. The appetite during the attack is more frequently lost, the patient being not merely afraid to eat, as are the patients with ulcer. The test meal is often of great value, there being in rather more than 50 per cent of the cases a marked diminution in the free hydrochloric acid. In a previous paper I have shown that in my experience a gastric ulcer is almost universally associated with a slight or considerable increase in hydrochloric acid, so that should a test meal in a doubtful case show only a trace of free hydrochloric acid, I would regard it as one of the strongest evidences of the absence of an ulcer. If, however, there is a slight increase, the evidence is not so valuable. The patient is more likely to have an ulcer, but it is possible that this lesion may be absent. On examination, the shape of the abdomen, the presence of dilatation of the cæcum, and mobility of the right kidney, are all points which would suggest the presence of visceroptosis. In cases of doubt an *x*-ray examination after a bismuth meal will often prove of great value.

CASES RESEMBLING CHOLELITHIASIS.

There were 6 cases whose symptoms resembled those given by gall-stones. Of these, 2 were males and 4 females. The ages varied from thirty-six to sixty-one, the average being forty-five.

The history of the symptoms extended from a period of five weeks to twenty years. The patients all complained of indigestion, flatulence, or windy spasms of the same type as the symptoms which are now being recognized as

so characteristic of gall-stones situated within the gall-bladder. As in the case of true gall-stones, it was found on further investigation that these symptoms consisted of slight discomfort and fullness in the epigastrium and right hypochondrium coming on immediately after food or even before the meal was finished. As a rule, these symptoms would occur every day without intermission, although in one case they were only present during the severe attacks. Flatulence would be a very marked feature, and the eructation of gas would be followed by considerable relief. Vomiting did not occur unless pain was more severe.

In addition to the constant symptoms, 5 of the cases showed a varying number of periods of more severe pain. In 2 of these it persisted for several days : it was severe, but bearable, and was increased by the ingestion of food. It would be associated with vomiting, which, however, would bring but little relief. Such attacks are found very frequently with stones in the gall-bladder, and as I have previously shown,[23] are then probably due to subacute cholecystitis. The 3 other patients complained of more severe pain, lasting for only a few hours and radiating from the right hypochondrium to the back. This was described either as being colicky in nature or as causing sweating or retching. The condition was apparently true colic, and one of the two cases mentioned above had also one such attack in addition to the pain due to the cholecystitis. Of the cases in these series, 2 presented a very movable kidney, which at operation required fixation, and it is probable that the colicky symptoms were those which have been frequently described as Dietl's crises, which are apparently due to the mobile kidney pulling upon and obstructing the common bile-duct. This symptom, added to the dyspeptic symptoms caused by the visceroptosis, increased the similarity to gall-stones. In only one case had there been any evidence of loss of blood : in this case the patient had stated that the motions were dark after the attacks, but no blood was discovered whilst the patient was in hospital. The appetite was as a rule poor, not only in the acute stages, but also in the intervals whilst the dyspeptic symptoms were alone present. Unfortunately the test meal was examined in only two of these cases, so that it was impossible to determine accurately what was the relationship between the loss of appetite and the amount of free hydrochloric acid. Of the two test meals, one contained 0·17 per cent of free hydrochloric acid, while in the other it was absent. In the first case the total acidity was 67 and in the second 42, so that here, as with those cases which resembled gastric ulcer, there seemed to be some variation in the nature of the test meal.

On examination, there was often evidence as to the true condition. The abdomen presented the general shape already described. There would be gurgling over the cæcum, and possibly a mobile kidney. In one case there was a large Riedel's lobe which somewhat resembled a distended gall-bladder. The differential diagnosis between a distended gall-bladder and a Riedel's lobe has often had stress laid upon it, and it is interesting to note that in this patient there was no history of colic, although if the tumour had been a gall-bladder the dilatation would have followed the impaction of a stone in the cystic duct, which impaction would probably have given rise to colic. Not infrequently there was a certain amount of tenderness in the region of the

TABLE V.—**CASES OF VISCEROPTOSIS**

NAME, AGE, SEX, DATE	LENGTH OF ILLNESS	INDIGESTION	ATTACKS OF SEVERE PAIN	FLATULENCE	JAUNDICE	VOMITING	HÆMATEMESIS, MELÆNA
No. 1. Y. J., 36, Female. 4. 7. 1913	Five weeks	Constant pain and fullness p.c. Right hypochondrium, passing to R.I.F.	—	After meals. Relieves pain	No	No	No
No. 2. A. B., 36, Male. 23. 9. 1913	Typhoid nineteen years ago. Present symptoms ten years	Constant ten years. Discomfort and fullness immediately p.c. Right hypochondrium to right shoulder. Occasionally at night	Two attacks: (1) 1907. Lasted two hours. Caused sweating. (2) 1912. Lasted three hours. Resembling colic	After all meals. Relieves pain	No	Much retching in mornings but seldom vomits	No
No. 3. E. Y., 61, Female. 21. 4. 1914	Nine years	Discomfort p. c. in acute attacks only	Numerous attacks lasting eight to nine days. Once doubled her up. Caused sweating lasting for three hours	Constant after meals	No. But motions pale during attacks	Once in acute attack. No relief	No
No. 4. L. L., 44, Female. 12. 5. 1914	Three years.	Slight discomfort p. c.	Many attacks. Every seven to eight days in last four months. Severe colicky last two to three hours	—	Slight jaundice after each acute attack	In each acute attack. No relief	No
No. 5. A. M., 46, Male. 8. 9. 1914	Five to six years. Typhoid at age of seven	Constant discomfort immediately p. c.	Three attacks. Severe pain right hypochondrium lasting one week	After meals. More severe in acute attacks	No	No	No
No. 6. M.K., 48, Female. 9. 11. 1914	Twenty years	Constant discomfort and fullness immediately p.c. Right hypochondrium	Several two to three years. Often at night. Makes her walk about. Lasting one to five hours	Slight twenty years	Several times after acute attacks	Retching in acute attacks. No vomiting	Never hæmatemesis. Occasional dark motions after attack

RESEMBLING CHOLELITHIASIS.

OTHER SYMPTOMS	PHYSICAL SIGNS	CONDITION AT OPERATION	TREATMENT	AFTER-RESULTS
Pain and frequency of micturition	Weak abdominal wall Visible peristalsis. Tumour right lumbar region continuous with liver. Narrow abdomen	Marked visceroptosis. Liver prolapsed. Large Riedel's lobe. Jackson's membrane. Gall-bladder normal	Abdomen closed. Belt ordered	Considerable relief for three months. Then return of symptoms
Appetite poor	Gurgling over cæcum. Right kidney movable	Gall-bladder normal. Visceroptosis. Movable cæcum. Jackson's membrane. Movable kidney	Kidney fixed	Remained free from all symptoms. Kidney well fixed
Appetite poor	Tenderness, right upper rectus. Distended cæcum. Gall-bladder not felt. Long narrow abdomen	Gall-bladder normal. Membrane from it to colon. General visceroptosis. Duodenum and cæcum very movable. Jackson's membrane	Membranes divided. Appendicectomy.	Considerable improvement for two months. Since then gradual return of symptoms
Wasting, one stone in ten months	Thin. Narrow abdomen. Right kidney palpable. Distended cæcum	Gall-bladder—no stones. Visceroptosis. Movable cæcum. Jackson's membrane. Marked Lane's kink	Membranes divided. Kink freed	One month later. Still having attacks of pain, but vomiting did not relieve pain. Belt ordered. Two months later, another attack of pain and jaundice with vomiting.
—	Gurgling over cæcum. Gall-bladder not felt. *X* rays showed slight shadow in gall-bladder region	Gall-bladder—no gall-stones. General visceroptosis. Movable cæcum. Jackson's membrane	Membrane's divided. Belt ordered	Three months later. Still some pain in back and soreness R.I.F. No pain after food
Pain and frequency of micturition	Tenderness right hypochondrium. Movable kidney. Dilated cæcum. Narrow abdomen	Gall-bladder—no gall-stones. General visceroptosis. Movable cæcum. Jackson's membrane. Kidney very movable	Kidney fixed	Except for slight flatulence remained well for six months after operation.

right upper rectus, although in no case was there a true Murphy's sign or the presence of superficial tenderness over the 8th to the 12th dorsal segments posteriorly.

At operation, the same pathological conditions were found as have been described in the previous groups. There was the same general visceroptosis, the presence of bands and membranes, and the evidence of local spasm in the stomach wall. In two of the cases the kidney was found to be so mobile that it was considered wise to fix it through another incision in the loin. Apart from this, the operative procedures consisted of division of the adventitious bands and adhesions and, if necessary, removal of the appendix. Later an abdominal belt was ordered. It will be seen from the table that the best results were obtained where the kidney had been fixed; in both these cases there was complete freedom from symptoms after the operation. In the other cases, in which little had been done beyond the division of bands and adhesions, the cure was but temporary, the period of relief lasting for two or three months only, after which the symptoms gradually returned. The wearing of a belt did not add to the patient's comfort to any great extent.

ILLUSTRATIVE CASE.

M. K., female, age 48. For twenty years the patient had suffered from fullness and discomfort immediately after meals. These symptoms were associated with flatulence, the eructation of gas being followed by some relief. During the last two or three years she had had, in addition to the constant discomfort, several attacks of very severe pain, which would come on at any time irrespective of all food, and not infrequently would wake her at night. At these times the pain, which was situated in the right hypochondrium and passed to the back, was so severe that she had to walk about. It would be associated with retching, but there was no vomiting. Several times she had been distinctly jaundiced afterwards. There had never been any hæmatemesis. Occasionally the stools had been dark, suggesting melæna. She was admitted to hospital on November 19, 1914. On examination, there was tenderness in the right hypochondrium, but the gall-bladder could not be felt. The kidney was distinctly movable and there was a dilated cæcum. The abdomen was narrow and the abdominal wall poorly developed.

An operation was performed two days after admission, the abdomen being opened by an upper right rectus incision. The gall-bladder was found distended with bile, but it was easily emptied, and no gall-stones were present. There was marked general visceroptosis, the stomach being prolapsed and somewhat dilated. The cæcum was freely movable so that it was easily withdrawn through the incision in the upper abdomen, and there was on the outer side a well-defined Jackson's membrane. The kidney could be felt freely movable. The abdominal wound was closed, and the kidney fixed through a separate incision in the loin. Convalescence was uneventful, and excepting for slight flatulence and discomfort after meals, she has remained well until six months after operation, the greater part of the symptoms in her case being due to the mobile kidney.

The details of the six cases in this group are given in *Table V*.

Diagnosis.—The differential diagnosis in this group is somewhat difficult, for the symptoms of gall-stones are not so sharply defined as are those of gastric ulcer; and the almost constant presence of the symptoms, which is so common with visceroptosis and so rare with gastric ulcer, will also be found with gall-stones. The absence of any pyrexia in the attacks resembling cholecystitis is suggestive that such an infection is not present, and the

difference in the radiation of the pain in those resembling colic may also be of slight help. It is, however, rather upon the clinical examination that the differential diagnosis will rest. The gall-bladder will not be found enlarged, there is no true Murphy's sign, and superficial tenderness posteriorly is absent. The characteristic shape of the abdomen, the dilatation of the stomach and cæcum, and the presence of a mobile kidney will all be points of value. It is now, however, clearly recognized that gall-stones are not uncommonly found in patients who are suffering from visceroptosis, so that it may be impossible to arrive at a certain diagnosis without an exploratory laparotomy.

CASES RESEMBLING CARCINOMA OF THE STOMACH.

This group includes but 5 cases. It will be noticed that it differs from the other groups in that 4 were males, 1 alone being a female. The average age was fifty-five, which is again considerably above that of the other groups. The cases, though few in number, are important, for with carcinoma of the stomach—which has so good a prognosis if operated upon in the early stage, but presents so poor an outlook when the disease is advanced—it is essential that operation be undertaken early, and for this reason it may be unwise to wait until the diagnosis is certain.

It will be seen that all five cases presented a short history. This is an interesting fact, for with the pathological changes of this nature one would expect, as was indeed the case in most of the other groups, to find the symptoms persisting over many years. The explanation of the fact is somewhat difficult. It is possible that they are all cases of acquired visceroptosis and that the symptoms only develop in later years when the abdominal muscles are getting weak. The patients gave a history of some three or four months' pain situated in the epigastrium or right hypochondrium, and which for that period of time had been constant. There had been no remissions and definite exacerbations such as have been found, even if ill-defined, in the other groups. In the majority the pain was slight, and consisted rather of a constant discomfort increased by the ingestion of food. In others the relation of the discomfort to food would be indefinite, being sometimes increased and sometimes decreased. If increased, this would be noticed in a relatively short time, generally from ten to fifteen minutes. Rarely the pain would be slightly present at night.

Vomiting might be definitely present, or there might be only much nausea, with the regurgitation of bitter or acid stomach contents. When present it was frequent, occurring more than once a day and sometimes after every meal. It would then be small in amount and give little or no relief to the pain. It would also be associated with the regurgitation of much gas, and the patient might complain of considerable flatulence and distention after food. This would be relieved by the regurgitation or vomiting, but the pain or discomfort would persist. In only one case was there any blood with the vomit, this being but small in quantity. This is true not only for visible blood, but in the other cases where vomiting was present there was no trace of blood even on chemical examination. The case which had the one attack of hæmatemesis also gave a history of the passage of several dark stools, which might have been due to the presence of altered blood, although no such condition was found during the stay in hospital.

The appetite is generally severely affected, as in most of the other groups. It would be found that since the onset of symptoms there had been a steady loss of the desire for food, this being generally most marked for meat foods. Again in this group it was made clear that the change was a true loss, not simply the fear of taking food owing to the discomfort produced. With this change in the appetite there would be a loss of weight, and it is noticeable that the one case which showed no change in the appetite showed no wasting. In the others the loss had been steady and progressive, one patient losing one and a half stone in seven months.

In all 5 cases a test meal was taken, and in 4 there was no trace of free hydrochloric acid. In the remaining case the free hydrochloric acid was 0·09 per cent, and as was to be expected, this was the case which had no loss of appetite and no loss of weight. The total acidity varied considerably, being probably dependent upon the presence or absence of acids produced by decomposition changes.

On physical examination, the patient would generally be thin and wasted, and might even present a certain amount of anæmia. In no case was a tumour palpable; but even in cases of true carcinoma it is not common to meet with this symptom unless the tumour be situated on the greater curvature or on the pylorus. A certain amount of tenderness and rigidity might be present in the epigastrium or beneath the upper right rectus, and occasionally splashing and gurgling could be obtained in the stomach or cæcal areas, but in no case was the kidney palpable before operation. In every case the nervous system was investigated, the presence of knee-jerks and the absence of ocular symptoms precluding the possibility of the phenomena being due to an unrecognized tabes dorsalis.

At operation, there was no evidence of carcinoma or other organic gastric lesion. The whole of the stomach was carefully palpated, the greater part of the viscus being withdrawn through the abdominal wound, and the posterior surface examined by an opening made either into the great omentum or through the mesocolon. Each case, however, showed certain characteristics of the condition of visceroptosis. Although there was no evidence of new growth, the stomach, as in the other groups, often showed a marked tendency to spasm of the muscular wall of the portion handled. The organ would be prolapsed and dilated, the cæcum being in a similar condition. There was a typical Jackson's membrane on the outer and anterior surface of this latter organ, and in several there was a well-marked Lane's kink. In some cases membrane-like adhesions would be found between the gall-bladder and colon. The operative procedures consisted of division of any bands or adhesions, but there was no indication for the performance of a gastro-enterostomy, with or without occlusion of the pylorus.

The results of operation were again not wholly satisfactory. There would be very considerable relief for two or three months, probably owing to the fact that during this period the patient would lead a more restful life than customary, and would partake of a considerably modified diet. After this period the symptoms would gradually recur, but might be relieved by the application of a belt. One case alone continued to have considerable relief ten months after operation, but even here there was a certain amount of flatulence.

ILLUSTRATIVE CASE.

C. A., male, age 48. Until seven months before admission he had enjoyed perfect health. Since this period he has had constant indefinite pain and discomfort in the epigastrium and right hypochondrium. At no time has it been severe, but has shown a tendency to increase. There was no definite relationship to meals, food sometimes increasing and sometimes relieving the pain. With the discomfort there has been much flatulence and the regurgitation of bitter fluid. Vomiting has been slight, but when present did not relieve the pain. On one occasion there was a slight hæmatemesis, but several times he has passed dark stools, the colour of which his doctor thought might be due to the presence of blood. Ever since the onset of his symptoms his appetite has been deteriorating, so that on his admission to hospital on March 30, 1914, he felt no desire for food. During the same periods he had lost one and a half stone in weight.

On examination, he was somewhat wasted. There was tenderness over the right upper rectus, but nothing could be felt in this area. Knee-jerks were present. A test meal showed the absence of free hydrochloric acid and a total acidity of 41. The abdomen was opened by an upper right rectus incision, the muscle being displaced outwards. The stomach was found to be prolapsed and dilated, the walls readily passing into local spasm. There were membrane-like adhesions between the ascending and transverse colon. The cæcum was movable and showed a well-developed Jackson's membrane. The terminal ileum was bound down by an accessory fibrous band on the under surface of the mesentery. The appendix passed behind the cæcum, and was partly covered by the Jackson's membrane. The bands and adhesions were divided, the appendix removed, and the abdomen closed.

He made an uninterrupted convalescence, and showed a certain amount of relief from the operation. He still continues, however, to have some discomfort after food, although his appetite has somewhat increased. Occasionally there is slight vomiting.

Diagnosis.—The details of the cases in this group show a closer resemblance to organic disease than any of the others. There is a short history of gastric symptoms, occurring most commonly in a male over the age of thirty-five who had previously been free from any symptoms of gastric trouble—a factor which in itself is very suggestive of the presence of carcinoma. There is the same constancy of the symptoms, without the presence of any periodicity. The pain, as in carcinoma, is not a marked factor, and is in fact often described as a constant discomfort rather than pain. It is present during the whole of the day, but tends to be somewhat increased after a meal. If the pain is sharp and has a very definite relationship to food, it would suggest the presence of visceroptosis rather than carcinoma. The vomiting will not help the differential diagnosis. It is small in quantity, and indeed often takes the form of a regurgitation of bitter fluid, a condition which is frequently found in carcinoma. As in the case of the latter condition, vomiting if present causes little or no relief. The appetite is bad; there is wasting; and the test meal is generally identical with that of carcinoma. Should the free hydrochloric acid be increased in quantity, it may again give rise to the suspicion of the presence of visceroptosis rather than carcinoma. On examination, definite physical signs are as a rule absent, although the evidence of dilatation of the cæcum may again point to visceroptosis. It will be seen, therefore, that the differential diagnosis is associated with considerable difficulty; and as it is essential that a carcinoma, if present, should be operated upon at as early a date as possible, it will be generally wiser to perform a laparotomy if any doubt exists, rather than take the risk of leaving an

TABLE VI.—**CASES OF VISCEROPTOSIS RESEM**

NAME, AGE, SEX, DATE	LENGTH OF ILLNESS	PAIN	VOMITING	HÆMATEMESIS	APPETITE	WASTING	TEST MEAL	PHY
No. 1. B. C., 52, Female. 28. 4. 1914	Six to seven months	Seldom free. Increased ten minutes p. c. Not very severe. Not at night. Epigastrium	Every day. Small quantities after most meals. Associated with flatulence. Gives slight relief	Never	Steadily decreasing since onset of symptoms	Very marked six months	Free HCl absent. T. A. 11	Wasted. Gurgling stomach present
No. 2. C. A., 48, Male. 30. 3. 1914	Seven months	Constant. No definite relation to food. Sometimes increased, sometimes decreased. Not severe. Right hypochondrium. Not at night	Very slight vomitting. Occasional regurgitation. Much flatulence after meals	Once only. Several attacks of doubtful melæna	Very poor since beginning of pain	Lost one and a half stone	Free HCl absent. T. A. 41	Well-de derness rectus. Knee-je
No. 3. J. D., 67, Male. 13. 8. 1914	Three months	Slight. Constant discomfort. No true pain	Much nausea. Only occasional vomiting. Nausea immediately p.c.	Never	Loss of appetite most marked symptom. Most marked to meat foods	Steadily weaker and thinner three months	Free HCl absent. T. A. 19	Wasted. gurgling No tu jerks pre
No. 4. S. F., 44, Male. 28. 1. 1915	Six weeks. Two slight attacks of indigestion, two and ten years ago	Continuous, slight. Discomfort, slightly at night. Somewhat increased by food. In epigastrium	One and a half hours p.c., only regurgitation of bitter fluid. Slight relief of pain	Never	Not affected	No loss of weight	Free HCl 0·09 per cent. T. A. 44	Splashing and cæ tumou present
No. 5. H. S., 65, Male. 16. 2. 1915	Six months, but flatulence ten years	Sharp half an hour to one hour p. c. Not entirely relieved before next meal.	Half an hour to one hour p.c. Relieves pain considerably	Never	Appetite very poor	Wasted and weaker	Free HCl absent. T. A. 46	Tenderne right up tumour. present

RESEMBLING CARCINOMA OF THE STOMACH.

PHYSICAL SIGNS	CONDITION AT OPERATION	TREATMENT	AFTER-RESULTS
Wasted. No tumour. Gurgling of cæcum and stomach. Knee-jerks present	General visceroptosis. Stomach dilated. Otherwise normal. Kidney movable. Movable cæcum. Jackson's membrane. Lane's kink	Bands and membranes divided. Abdomen closed	Improved for two months. Then return of symptoms. Belt ordered. Improved; not completely relieved
Well-developed tenderness right upper rectus. No tumour. Knee-jerks present	Stomach dilated. Adhesions between ascending and transverse colon. Movable cæcum. Jackson's membrane. Lane's kink.	Bands and adhesions divided. Appendicectomy	Some relief from operation. Still continued to have some discomfort, after food, with occasional vomiting
Wasted. Splashing and gurgling stomach area. No tumour. Knee-jerks present	General visceroptosis. Stomach and cæcum dilated and movable. Jackson's membrane	Abdomen closed	8. 6. 1915. Much better since operation. With the exception of slight flatulence has none of his old symptoms
Splashing in stomach and cæcal area. No tumour. Knee-jerks present	General visceroptosis. Stomach dilated. Otherwise normal. Adhesions between gall-bladder and duodenum. Movable cæcum. Jackson's membrane	Bands and adhesions divided	Little relief from operation. Contracted pneumonia two months later, from which he died
Tenderness and rigidity right upper rectus. No tumour. Knee-jerks present	General visceroptosis. Stomach dilated. Adhesions between gall-bladder and duodenum. Movable cæcum. Jackson's membrane	Abdomen closed	Pain considerably relieved two months after operation

early carcinoma unoperated upon. Fortunately the chances of error are not very great, for this clinical type of disease is relatively rare; but even if it should be the sole condition present, a certain amount of relief may be afforded by the division of the membranes and bands.

CONCLUSIONS.

A consideration of the above cases leads to the following conclusions :—

1. Visceroptosis commonly simulates organic lesions of the appendix, stomach, and gall-bladder.

2. The simulation, excepting in the case of carcinoma of the stomach, is generally incomplete, so that a differential diagnosis can often be made.

3. Occasionally visceroptosis co-exists with one of these lesions. This combination adds considerably to the difficulty of diagnosis.

4. The results of operative treatment are unsatisfactory; but if there is any question of the possibility of a combined lesion, an operation should be performed; otherwise medical treatment should first be carried out.

5. In the cases resembling carcinoma of the stomach, operation should always be performed lest an early neoplasm be overlooked, with grave results.

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A CASE OF PAGET'S DISEASE (OSTEITIS DEFORMANS), WITH A NOTE UPON THE PATHOLOGY.

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Cases of Paget's disease, whilst much commoner than was at one time believed,* are sufficiently rare to be of interest, particularly since the riddle of their pathogenesis has not yet been solved.

The case now reported occurred in the practice of Dr. W. T. Barrett, of this city, who referred him to the writer for an opinion and for radiography. I am indebted to Dr. Barrett for the present use of his case.

Case History.—The patient was a male, age 67. Originally he was considerably above the average in stature and in physical strength. He had not especially noted any of the subtle changes of osteitis deformans, save that his legs were bent and he was becoming unaccountably weaker. His general appearance was, however, typical of Paget's disease. The head was sunk upon the chest, the spine generally curved, the legs bowed out so that with the feet approximated there was a gap of one foot between the medial femoral condyles.

Briefly stated, the changes in the skeleton induced by this disease may be said to be of a static nature, owing to the general softening of the bones, which is the chief feature of the earlier stages of the affection. Thus all the bony curves come to be exaggerated, and later a new deposit of bone beneath the periosteum and sometimes in the medullary cavity, leads to a considerable thickening of the bones. Nothing could better describe the attitude of the sufferer from Paget's disease than the adjective 'simian,' as the early weakness of the bones leads to a stooping attitude very reminiscent of the anthropoids.

In the present case a shortening of over 3 in. had occurred. He had originally measured 6 ft. $3\frac{1}{4}$ in., and was now barely 6 ft. The deposit of new bone on the surface of the cranial vault, well shown in *Fig.* 70, had increased the size of his head, so that he now wore a $7\frac{1}{2}$-sized hat in place of one of $6\frac{7}{8}$, the circumference of his head now being $23\frac{1}{2}$ in. The zygomatic processes were very much bowed, especially on the right side, producing facial asymmetry. The lower jaw was slightly prognathous, but this is probably due to the loss of all the front teeth in the upper jaw (*Fig.* 70). Myers[1] and Parry[2] both report cases of osteitis deformans in which the lower jaw was unduly prominent. The case figured by Bowlby[16] has a prominent lower jaw. Attention has not been drawn to this point, so far as we are aware. It may possibly indicate some pituitary change.

The external surface of the skull presented irregular elevations and depressions. The head was much squarer than it had been, not only because

* Approximately 158 cases had been reported up to 1910 (Ellis).[8]

of the new bony deposits, but probably also from compensatory widening which Léri[5] has described as accompanying the sinking of the skull on its base. The facial expression had become much altered, judging from a photograph of the patient taken twenty years ago. Changes in the facial bones have occurred, and with these changes the attachments of the muscles of expression will have become altered too, thus recasting the face.

The thorax was fixed and rigid, the breathing mostly abdominal. The chest was also considerably compressed from side to side, making it very deep

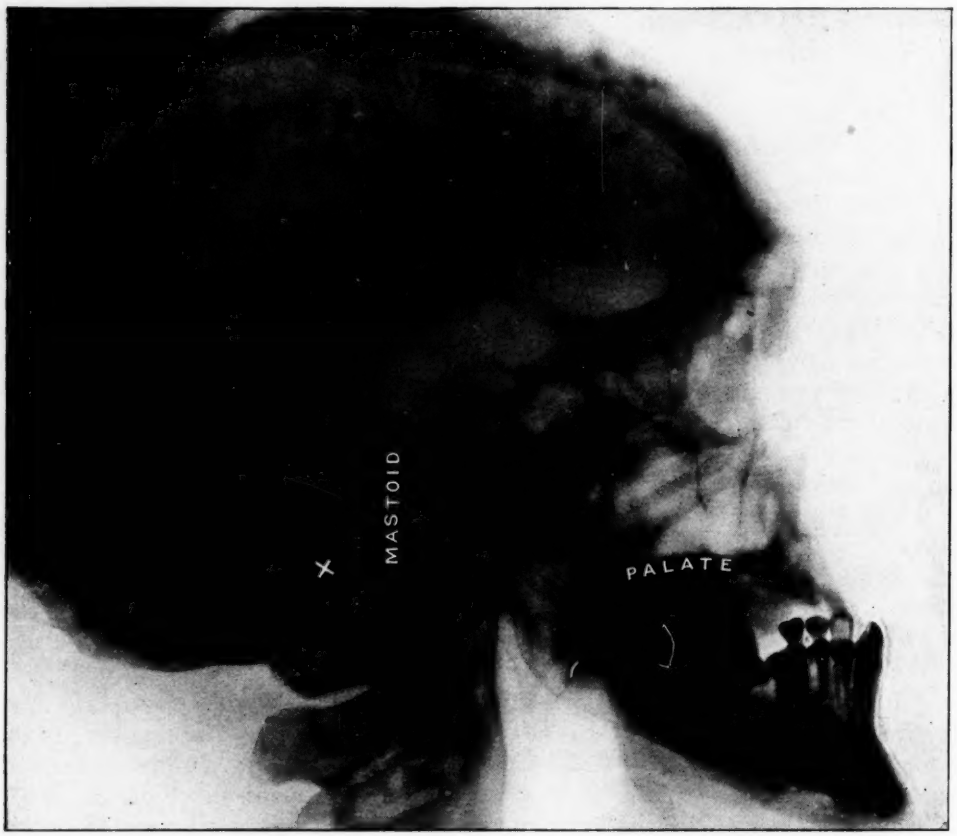

FIG. 70.—PAGET'S DISEASE: SKULL.

Opisthion X. Shows slight 'convexobasie' of Léri. Great thickening of calvarium affecting outer table and diploe; cranial chamber uninvaded (see text). Large sphenoidal sinus. Sella turcica probably normal, though dorsum ephipii is very faint.

from before backward, but not very broad. The ribs seem to have become fixed in a very oblique position, resembling that seen at the end of expiration. This fixation of the chest in the expiratory position is rather typical of osteitis deformans. A skiagram shows that new bone has been deposited upon the ribs, a situation not commonly described as affected, though Emerson[3] mentions it. The vertebral column was severely affected, the thoracic and lower cervical vertebræ more than the lumbar. Thus a certain amount of flexion

and extension of the spine from the lumbar region is possible, the thorax moving as a rigid whole. Extension was somewhat limited, not alone by bone trouble, but by loss of elasticity in the thorax, to which last the recti-abdominales were attached like strings to a bow. It was impossible for him to lie flat on his back on the table, for not only was the thoracic spine ankylosed in an exaggeration of its normal curves, but he complained of the pull of the abdominal muscles on his chest when he attempted to straighten out.

The clavicles were thickened and bowed, the ossa ilii splayed outwards, and coxa vara was present to a marked degree, abduction at the hip being greatly limited.

Over the upper third of the left tibia was a discharging sinus, the result of a blow in an iron-works some two years ago. The skin over both tibiæ was much discoloured and scaly, though it has never been ulcerated. Higbee and Ellis[8] describe the same condition in their case. The fleshy parts of the legs were very much reduced, so that the skin formed a thin covering to the large bones, and the muscle tissue was much less in amount than the bone.

Arterial calcification was present to an extraordinary degree, so that the plantar artery (*Fig.* 72), as well as the posterior tibial (*Fig.* 74) and the arteria princeps pollicis and palmar arch (*Fig.* 71), can be seen in the radiographs.

So far the patient is alive and in moderately good health.

Description of Radiographs.—The accompanying radiographs will be seen to bring out some interesting points.

Head (*Fig.* 70).—A skiagram of the head such as the figure shown corresponds more or less accurately to the anatomists' medial sagittal section of the skull. The bones of the vertex are seen to be greatly increased in thickness (cf. this radiograph with the well-known sagittal section of a skull with osteitis deformans in Thompson and Miles's *Manual of Surgery*, 1909, *Fig.* 249). The inner table is seen as a sharp line in the occipital region, but becomes blurred about the bregma. This and the mottling of the bone immediately below it are probably caused by changes in the outer table and diploe. But Hann[4] has reported a case in which the anterior half of the inner surface of the cranial vault showed a congeries of flattened bony bosses, whilst the hinder part was quite smooth. The possibility of this occurrence must be borne in mind in interpreting the present skiagram.

The examination of the bones of the base of the skull is given an added interest by the observations of Léri.[5] He has shown that an upward projection of the bones of the cranial base in the immediate neighbourhood of the foramen magnum is found in osteitis deformans. This upward deformation of the base he calls 'convexobasie,' and the general levelling up of the whole base he calls 'platybasie.' The foramina at the base, both vascular and neural, are also encroached on, as has long been known, but never to the extent seen in leontiasis ossea.* In the skiagram under discussion there is some indication of this raising of the base. The posterior border of the foramen magnum

* Prince[37] and Bockenheimer[38] consider the bone changes in Virchow's leontiasis ossea and Paget's disease to be identical. See also Bartlett.[36] There seems to be much reason in this claim.

(opisthion) is normally on the same level as the hard palate, and is also the lowest point in the posterior cranial fossa, and the plane of the foramen magnum is only slightly oblique. In the present case, the comparative levels of the hard palate and the lowest point in the posterior cranial fossa are unaltered, but this lowest point is certainly no longer the opisthion, although the situation of the foramen magnum is somewhat obscured in the skiagram by the shadow of the mastoid process. It appears then as if Léri was right, and that the foramen magnum has been distinctly raised above its normal position.

FIG. 71.—PAGET'S DISEASE: HAND.

Middle metacarpal bone shows considerably increased density—i.e., hypercalcification. The fourth is less affected. The remaining metacarpals and the phalanges show absorption of the trabeculæ—i.e., decalcification. Note traces of calcified arteries.

This is only to be expected. It is in fact a 'static' change in the head, comparable with that of the lower limbs. In the early stage of softening—and it is well to remember that the head has been noted as affected more often than any other bone,[6] and often at the outset of the disease—the base of the skull tends to mushroom over the vertebral column to a small but appreciable extent, and the lowest point of the posterior cranial fossa is no longer the opisthion but some point posterior to this.

The pituitary fossa will be seen to be exceptionally shallow and the

sphenoidal air sinus very large. This shallowness may be only apparent and due to exceptionally slight density of the posterior clinoid processes. This permeability introduces a possible fallacy into the proper interpretation of the pictures of this region. The remarkable control exerted by the pituitary gland over the stature generally gives any radiographical observations upon it in all general bone diseases a certain, if limited, value. The sellar outline was studied in Hurwitz's[7] cases, but found to be deformed in one only, and this seems to have been due to the softening of the base. Bartlett[36] (quoted

FIG. 72.—PAGET'S DISEASE: FOOT.
Marked deformity of astragalus; neck overgrown. Also of under surface of os calcis. Strong interlocking of bones. Calcified plantar artery. Large sesamoid bone beneath hallux.

by Higbee and Ellis) found the hypophysis definitely changed (hyperplasia) in one case of osteitis deformans, whilst Gruner, Scrimger, and Foster[9] reported a case of atrophy of that gland in this disease. Cushing[32] shows photographs of one of his series of acromegalies, case 29, whose attitude is very reminiscent of Paget's disease. Cushing regards this case as exhibiting a polyglandular syndrome.

The outline of the sella in radiographs gives us the size of the pituitary body, and expansion or erosion of this silhouette is suggestive of neoplastic change. On the other hand, the *x* rays are powerless to indicate any of the

subtle degenerative changes of this gland, changes which may be not active enough to disturb the small bony cavity in which it lies. This is a very important reservation.

Hand (*Fig.* 71).—The skiagram of the hand is especially interesting, in that little attention has hitherto been paid to the condition of this part. One bone, the middle metacarpal, is seen at once to be deeply affected; and

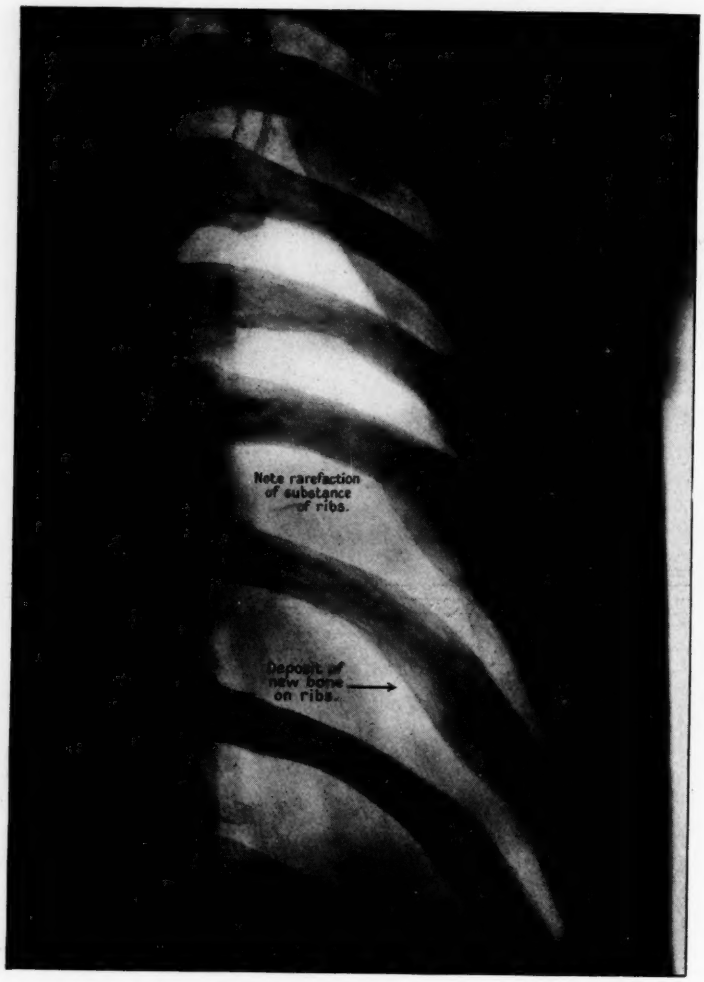

FIG. 73.—PAGET'S DISEASE: CHEST.

Marked changes in the ribs: rarefaction and also new bone deposit. The chest is very narrow for so large a man. Ribs fixed in expiratory position. Chest moved but little on respiration.

not only markedly increased in density but also widened. An equally interesting point is the condition of the remaining metacarpals and phalanges. A profound disturbance of the usual trabecular structure of the cancellous tissue of these short bones is seen to be in progress, calling to mind osteitis fibrosa and bone-cyst formation. The radiogram of the hand of case 1 of

Hurwitz[7] was evidently like the one under discussion, for Baetjer says of it: "Middle phalanges of index and fifth fingers show same condition [i.e., marked porosis], whereas those of the third and fourth fingers show distinctly increased calcification." Byrom Bramwell[10] showed a case at the Edinburgh Medico-Chirurgical Society in 1908, in which the osseous phalanges had to a great extent lost their calcareous matter. It is very probable that the bone changes visible here are illustrative of the earliest stages of Paget's disease, but they

FIG. 74.—PAGET'S DISEASE: UPPER END OF TIBIA AND FIBULA, AND KNEE-JOINT.

Lateral view. Shadow of fibula must be differentiated. Considerable rarefaction of upper end of tibia. Compact tissue is irregular and has lost the sharp outline of the normal. The medulla is wide, and the trabeculæ are replaced, except at the end, by an amorphous substance of varying density. Posterior tibial artery calcified.

are not absolutely characteristic of it, for Cushing shows a picture of an enormous acromegalic hand (*Fig.* 225, loc. cit.) with similar, though less, phalangeal absorption. There is no 'tufting' of the terminal phalanges in the writer's case.

The os magnum is more than ordinarily dense, as is the lower end of the radius; but the phalanges and most of the metacarpals give the impression of exceptional translucency, the compact tissue being reduced to a minimum.

On the original plate, traces of the following calcified arteries can be clearly seen: radial, ulnar, palmar arch, and princeps pollicis.

Foot (*Fig.* 72).—The normal outline of the astragalus is quite altered, as a deposit of new bone has obscured its neck, making it appear barrel-shaped in front. As there is a similar deposit posteriorly, the movements of the ankle-joint are considerably impaired. The os calcis is seen to be deformed as well, having a prominent bulge on its inferior surface. The arches of the foot are not destroyed, but the foot gives the impression of being a 'flat-foot' because of bony encroachments into the sole. Movements at the intertarsal joints are very limited, and an exaggeration of the normal interlocking of the bones can be made out. The tibia is very dense and widened. The calcified posterior tibial and plantar arteries can be seen.

Chest (*Fig.* 73).—The remarkable narrowness of this chest is one of the chief features. The ribs are very oblique, as is usual in this disease. (For a marked instance of this see White's case.[12]) The ribs show an irregular outline from subperiosteal bone deposit. They are also remarkably rarefied in places.

Long bones (*Fig.* 74).—Only one skiagram of a long bone in this case is reproduced: the less commonly observed lesions have been more fully illustrated instead: over twenty-five skiagrams were taken in all. The compact tissue of the tibia and femora was increased in amount to about double the normal, though in places it was in excess of this. At the same time, the thickening of the compact bone has not taken place at the expense of the marrow cavity, which is, if anything, wider than normal (see figure). The sharp outline of the compact bone has been lost, and it looks shreddy and porous on the skiagram, though it is hard to the touch and seems strong. Be that as it may, the compact tissue itself is not of uniform density; and further, its outer surface is frequently raised to form subperiosteal flakes and nodes. Some cases of Paget's disease seem to be much more nodular than others (see skiagram of skull of Hurwitz's[7] case 3, and also Sinclair White's[12] case). The normal trabeculation of the bone is destroyed except in the immediate vicinity of the joint surfaces, and its place is taken by an amorphous cloudy material of varying density, presumably osseous in character. The upper articular surface of the tibia was thickened to about $\frac{3}{8}$ in. There was no 'lipping' of the joint margin. The tibia and the ulna were very much denser to the *x* rays than the fibula and the radius.

Although Paget's disease is undoubtedly a general one, the manner in which some bones suffer more than others is rather puzzling. Cases have been reported in which only one bone has been involved—Guaccero,[13] Roth,[14] Laming Evans,[15] Bowlby,[16,39] and Hurwitz.[40] Herbert French[17] showed two cases in 1903 in which only two or three bones were affected.

Flaws can be found in even the most convincing cases of the so-called monoösteitic (Schlesinger) form of Paget's disease, such as those of Bowlby[39] and Hurwitz.[40] The latter very truly states that only about five authentic examples of this form exist. Many of the reported cases are spurious, as the diagnosis has been based upon a very insufficient examination. In Hurwitz's case, as in Bowlby's just referred to, it was the femur that was involved. Very

slight changes in the skull* and right tibia were found by the *x* rays, so that strictly speaking it is not a true example of the monoösteitic form, although it is published as such. It is highly probable that the authentic one-bone cases would be reduced to a number even less than Hurwitz suggests (i.e., five), if a very strict and critical examination had been made of the whole skeleton in each case.

The writer is aware that Schlesinger and Schirmer and others all believe that localized forms of Paget's disease may occur. His contention is that Paget's disease is a general affection, and that limitation to a single bone is extremely improbable. The changes in other bones may be very slight indeed as compared with the changes in one particular bone, but changes are nevertheless present, and will be found if a sufficiently careful *x*-ray or pathological examination be made.

The following case of Alexis Thomson's[18] has been included in the present commentary, although it was originally shown as an example of osteomyelitis fibrosa. The patient had "tumour-like bossing of the skull and multiple fractures and curvature of both femora." The similarity of this picture to that of certain cases of Paget's disease is obvious, and represents in the present writer's opinion a definite type of this affection. This point will be returned to shortly.

The arteries throughout the present case were calcified to an extraordinary degree.

PATHOLOGY.

We know so little at this date of the methods of formation of bone under normal conditions, that a general disease of the bony skeleton such as Paget's finds us without ground to build upon. The malady has been held by some in the past to be due to rheumatism, and again to syphilis. Recent advances in the pathology of the *Micrococcus rheumaticus* and the many diseases once indiscriminately classed as rheumatism on the one hand, and the use of the Wassermann reaction on the other, have shown that these views are incorrect.

If again we accept Macewen's theories of bone formation,[19] we might suppose the bony thickening to be due to a general degeneration of the periosteum, with consequent loss of its restraining action. This, however, could only account for the bony depositions, and not for the softening which is fully as characteristic as the bone overgrowth.

Before we can properly discuss the pathogenesis of this disease, we must have a clear idea of what we understand by the term 'Paget's disease.' And here a question at once arises: Do we mean a definite, constant, and characteristic microscopical, macroscopical, and *x*-ray picture? Or do we rather mean a disease of the bones whose only constant features are the attitude of the sufferer and certain bowings and thickenings of various bones? A very brief review

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* The sella turcica was normal, but the pineal gland was calcified. Pineal calcification was present in Bergeim's case also. In view of our scanty knowledge of the functions of this gland it would be unwise to speculate upon the significance of this occurrence.

Dandy has recently removed the pineal body from dogs by means of an ingenious operation. Loss of the gland produced no effects. (DANDY, W. E., "Extirpation of the Pineal Body," *Jour. Experim. Med.*, Aug., 1915.)

of the recorded cases is enough to show that the bone changes are far from constant, though in the main they all show absorption of bone with excessive production of fibro-osteoid tissue. Thus, Fitz states: "The surface (of the long bones) is smooth or rough, nodular or protuberant; the cortex thickened or thinned, spongy or eburnated; the cancellated structure sclerosed or coarsely trabeculated; the marrow spaces obliterated or transformed into cavities of various size" (quoted by Hurwitz[7]). Nothing could better illustrate the absence of a uniform change than this description, though the writer hopes to be able to show that these different pictures can be logically correlated. It is this lack of an absolutely characteristic change in the bones which causes the writer to protest against the use of the name 'Paget's disease' to label cases in which one bone alone has been affected. The outstanding feature of the disease, as Sir James Paget himself described it, was the multiplicity of the bones eventually affected.

The earliest change in the bones which occurs in this affection is softening, which leads to certain static changes, even in the bones of the cranium. Subsequent osteoid deposit only serves to make these deformities permanent. This decalcification must affect the whole length of the bones more or less impartially, as the bendings are general and regular. The deposit of new bone seems to occur very early, since patients describe the thickening as synchronous with the curvatures. It is not always quite exact to say that the bones are thickened; it is more true to say that they are widened (see *Fig.* 74). Further, it is commonly stated that the new bone is soft—i.e., that it is much richer in cellular elements than normal bone, since it is a truism to say that calcium and the alkaline earths do not vary in hardness. In some cases this relative richness in fibrous and other cellular tissue seems to exist throughout the course of the disease, whilst in others the bones are found to be hypercalcified at the time of death. There is every reason for believing that these latter cases have passed through the fibrous stage and should be regarded as cured. In this connection it is interesting to note that the bones have been found to differ greatly in hardness, and there is some varied evidence on this point. Thus in Hann's case the skull, although it was an inch thick in places, "was very vascular and soft, and cut with great ease with the saw" (loc. cit.). Similarly Ellis[8] describes Higbee's case at post-mortem: "The saw passes through the outer table very easily, the bone at points cutting as if it were marrow containing a few spicules of bone . . . The skull was very rich in blood . . . . the inner table is fairly solid throughout [cf. *Fig.* 70]. . . . Calvarium was 1·5 in. thick." On the other hand, the bones in the Royal United Hospital Museum, Bath, described by Waterhouse,[20] gave the impression of rugged strength, "as if hewn out of stone." The evidence as to the frequency of fractures is à propos of this point, and a similar contrast will be found here. For Dax[21] states that fractures are rare owing to the great strength of the bones; whilst in contrast with this are cases such as Thomson's (mentioned above), and as Parry's, where the patient fractured her femur through stooping to turn out a gas-ring.

The cases where histological examinations have been made point to the fact that there is a marked increase of fibrous tissue. Thus, several of the names that have been suggested as descriptive of this condition contain the

word 'fibrous'. Trabeculæ of the cancellous tissue become surrounded and replaced by fibrous tissue poor in cell elements (see Scott in Hann's case, loc. cit.). Dax[21] says that the condition very closely resembles osteitis fibrosa, except that cyst-formation is commoner than in the latter. There is also, he says, new bone-formation in excess of destruction; but this cannot always be the case, or fractures would never occur. It must be borne in mind, however, that the new bone (or more properly, the osteoid tissue) which is produced is at first soft, and may remain so. The new formation does not appear to be bone in the true sense; the process seems to be one of calcification rather than of true ossification.* The tissue is new and foreign to the bones—see the case of Higbee and Ellis, in which some of the deposits could be almost shelled out from a fibrous capsule. The normal sharp distinction between compact and cancellous bone is lost (see microscopical findings of Packard, Steele, and Kirkbride[6]).

Is Paget's Disease an Inflammation, as the synonym implies?—Von Recklinghausen (quoted by Elmslie[22]) believes that osteitis fibrosa deformans and Paget's disease are one and the same thing, and the large amount of organic tissue in the bones supports this observation, as a partial truth at least. Percy[33] believes that osteitis fibrosa cystica, Paget's disease, leontiasis ossea, and snuffle-disease of swine, are all the same. Guaccero[13] suggests the curious title 'fibrous megalo-osteomyelitis' as being expressive of the appearance of the microscopic sections of his case.

Opinion is certainly changing from the original view of Paget that his disease was a chronic, low inflammation. Sir Samuel Wilks, in a letter to *The Lancet*,[23] suggested the name 'osteoporosis deformans,' since he found no trace of true inflammation in his cases. The classical signs of inflammation are notably absent. Such inflammatory changes (ulcers, etc.) as are liable to occur in the lower limbs are due to the arterial degeneration which is so severe in, and so characteristic of, Paget's disease. More damaging to the inflammation theory is the testimony of Bergeim, who informs me that the bones in his case (to be reported shortly) were aseptic, and of Higbee and Ellis,[8] who found no bacteria in smears from the bones of their very carefully recorded case.

It has been suggested that Paget's disease may be caused by an upset of the internal secretory glands, and evidence is accumulating in support of this theory. The influence of the parathyroid, thyroid, and pituitary glands on the metabolism of the bone salts is becoming better known (see Erdheim,[30] MacCallum and Voegtlin,[31] and a collective review of this subject by Pool[29]). The bone-salt metabolism in two cases of Paget's disease, one late, one early, has been recently investigated by Da Costa, Funk, Bergeim, and Hawk.[24] They found a pronounced retention of calcium, magnesium, and phosphorus, and a pronounced loss of sulphur, indicating a stimulated osseous formation. The

* For an interesting paper on "Calcification and Ossification," see H. G. Wells, *Arch. of Inter. Med.*, Chicago, June, 1911. This author believes that any area of calcification may be changed into true bone in the course of time. He thinks that the colloids play a chief rôle in keeping the calcium salts in solution.

calcium content of the urine was very low, " a condition which we have found in other disturbances of the thyro-parathyroid mechanism [probably alluding to *Ref.* 35]. We have therefore concluded that this disorder (osteitis deformans) may involve an impaired function of this mechanism " (private communication from Olaf Bergeim). In the early case the CaO elimination averaged 0·118 gram per day, as compared with the 0·022 gram of the advanced case (for methods see *Ref.* 35, and also an instructive paper by Towles[34]). There was thus a slight retention even in the early case. This shows that the bone-salt changes in Paget's disease do not move altogether in one direction, as they do, for instance, in osteomalacia. Associated with the irregular decalcification, of which we have absolute proof in *x*-ray and histological pictures, there is an irregular bone production which seems at least to balance the bone substances removed. In Higbee and Ellis's case the thyroid was remarkably fibrous. The parathyroids could not be found, but may have been present, as it is notoriously difficult to find these structures in some cases. Askanazy reports that he has found an adenoma of the parathyroid in a case of osteitis deformans—(quoted by Harbitz).

Harbitz[41] describes a case of adenoma of the parathyroid that he found in a multipara of 26, dead of osteomalacia; similar cases are reported by Erdheim and Bauer, and by Strada. Molineus[42] has seen three cases of osteomalacia (or osteitis deformans) in which he has found small tumours of the parathyroids.

It is not easy to say always what Continental observers mean by osteomalacia, i.e. whether we should not call it Paget's disease. In Harbitz's case, which is a rather typical post-pregnancy example of osteomalacia, there was a new deposit of bone beneath the periosteum and cysts in the medullary cavity. This looks as if osteomalacia were the acute form of a disease (from which generalized osteitis fibrosa is indistinguishable) of which Paget's disease represents the chronic form.

Several cases are reported in the literature as much benefited by organotherapy. The improvement of several cases of rickets* treated with hypophysin by Weiss,[25] and the cure of three cases of osteomalacia by Koch[26] with pituitrin, and one case by Cavarzani[27] with epinephrin (making forty-seven cases in all so cured) may be cited as examples of the influence of the internal secretions on the metabolism of the bone salts. Finally, of course, we have the connection between disease of the hypophysis and acromegaly.

It seems therefore highly probable that the secret of the fundamental pathology of Paget's disease is locked up in the glands of internal secretion.

PROBABLE COURSE OF PAGET'S DISEASE.

The *x* rays may be of some value to the pathologist as well as to the clinician in demonstrating the type-character of the case—excessive rarefaction, excessive bone-salt deposit, or a modicum of both. For example, in the hand of the present case (*Fig.* 71) decalcification is obviously present in most

* Giuseppe Carpani believes that rickets is the result of a dystrophy of several of the endocrin glands, and has seen much benefit from opotherapy (see *Lancet*, 1915, i, 1302).

of the bones, and the disturbance of trabeculation is manifest, whilst in one or two of the bones the extreme blackness of the print points to extreme calcification.

The earliest changes in the bones are probably those of calcium absorption, during which time the bones are weakened and the static deformities are gradually produced. Whatever the metabolic upset is, it is evidently a slight one, as the disease is so very chronic and life is not especially threatened. The normal internal architecture of the bones is destroyed, and the medulla replaced by fibrous tissue which represents the decalcified trabeculæ and added cellular material. Paget's disease may progress along these lines and present itself chiefly as a fibrous transformation—as in Alexis Thomson's case of osteomyelitis fibrosa, or as an osteitis fibrosa deformans of von Recklinghausen. It is noteworthy that M. B. Schmidt introduces a description of osteomyelitis fibrosa in the middle of his account of Paget's disease in Aschoff's *Pathology*.[28]

More commonly there is considerable formation of new bone, abnormally rich in cellular elements, causing it to appear very porous. Why this bony growth should occur when the outstanding feature has just been, or still is, bone absorption, is not clear. It may be that Lanceraux was not far wrong when he considered this osseous proliferation to be reactionary. In the later stages the bones become greatly hardened by the profuse deposit of bone salts, and as far as the actual disease goes we may regard marked examples of this occurrence as cured, though of course such a condition of sclerosis may be anything but a blessing. Emerson says: "Early in the disease the new bone is fine, porous, vascular, and so soft that it can be cut with a knife; but it hardens progressively until in ten years or more it may be like ivory, or become loose and friable" (loc. cit., p. 718). The accounts of conditions found post mortem vary with the stage of the disease at which the patient died. Some cases must suffer from an exceptional decalcification, judging from the brittleness of the bone during life. The arterial calcification which is so common is only a further sign of the upset metabolic processes, and by no means a cause of the bone trouble, as has been suggested.

Therapeutically, benefit has occurred from calcium lactate—which replaces that being excreted or hastens the final calcification of the bones—and also from thyroid extract, which strikes more fundamentally at the cause of the disease. Amputation has been performed once only, so far as the writer is aware, by Guaccero (loc. cit.). The tibia alone was involved in his case, and the leg was sacrificed in the hope of arresting the disease. What happened subsequently is not stated, but in the light of present knowledge such treatment would be strongly contra-indicated.

Finally, it would be better to use the term Paget's disease, which is at least non-committal, in preference to osteitis deformans, which is certainly a misnomer.

SUMMARY.

Paget's disease is in all probability not an inflammation, but an upset of the internal secretions (especially thyro-parathyroid) which control the calcium exchange of the body.

The early stages of the disease are characterized by a general decalcification, bringing the affection into line with osteomyelitis fibrosa and to a limited extent with osteomalacia. At the same time an irregular bony proliferation occurs, sufficient in amount to overshadow in the urinary and intestinal excretion the absorbed bone salts.

The disease may progress along different lines, presenting itself as an osteomyelitis fibrosa, or having excessive lime deposits, the average case being the mean between these two.

Although a general disease, certain bones are more severely affected than others.

The disease may be impossible to diagnose whilst a single bone is affected, though the *x* rays will often reveal disease in the early stages in other bones where it had not been thought to exist.

Later, bone salts are deposited in large amounts, this stage being associated with calcium, magnesium, and phosphorus retention, as has been proved by experiment.

During the stage of softening, which may be prolonged and gradual, deformities are produced in all the bones, including the skull.

The several varieties of bone change which have been described by various observers of this disease may be explained by the morphological differences which the bones present at different stages of the malady, and the different types—the fibrous or the osseous tissue predominating—which it may assume.

Benefit may be looked for from the oral administration of extracts of internal secretory glands, though once deformities have occurred they will persist even if the disease is arrested.

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NAVAL AND MILITARY SURGERY.

CASES OF GAS POISONING AMONG THE BRITISH TROOPS IN FLANDERS.

By Col. Sir JOHN ROSE BRADFORD, K.C.M.G., C.B., F.R.S., A.M.S., and Capt. T. R. ELLIOTT, F.R.S., R.A.M.C.

At the date when these notes were written—namely, the last week of June—there had been three chief attacks made on the English lines by the enemy under cover of asphyxiating gases. The first took place on April 23 and 24, immediately to the north of Ypres. The day before this, gas had suddenly been poured upon a sector of the French line adjoining the left of the British, and the stifling fumes were so unexpected that the Algerian and Zouave defence broke before them. Warned by this, but otherwise unprepared, the Canadian troops and various English units had to face similar attacks on the following days. No respirators were available. The nature of the gas and its later effects on the men were entirely unknown. The troops held their ground, but the losses were heavy.

From May 2 to May 5 a second attack with gas was made south of Ypres. Pad respirators, moistened with a solution of bicarbonate of soda, had now been improvised, and these gave the men some slight protection.

The third attack was on May 24. By this time much better respirators were available, and the sufferings of the men were correspondingly less.

In addition to the trench gas, which is supposed to be emitted from cylinders, and has been proved by various indirect tests to consist chiefly of chlorine, the Germans have employed special asphyxiating shells, which contain other substances that cause more direct stupefaction, or are more directly irritating to the eyes and produce a temporary blindness. Their nature is not fully known, but organic compounds of bromine have been identified among them.

The following account deals only with the results of exposure to the trench gas, and chiefly it describes the condition of the soldiers who suffered from the poisoning in its acutest form before the use of adequate respirators. The symptoms may be grouped under three headings, according as they are caused by (*a*) irritation of the respiratory tract, (*b*) gastric irritation, (*c*) a general toxic action.

Death is liable to occur at any one of three successive stages of injury produced by the poison—namely: (1) *In the first few hours on the field*, the patient then presenting a greenish-yellow aspect, like that of asphyxia pallida. This is apparently the result of direct poisoning; (2) *Up to the fourth or*

fifth day, when the man is overwhelmed by a livid asphyxia due to œdema and disruptive emphysema of the lungs; (3) *Later, at any time up to the end of the second week*, from inflammatory complications, such as purulent bronchitis or bronchopneumonia, with pleurisy and heart failure. Only one death has been recorded at the end of the third week, and that was from generalized emphysema with heart failure.

1. **On the Field.**—All the men gave the same description of what they felt as the greenish-yellow fumes enveloped them. Choking, coughing, gasping for breath, and inability to speak, proved the irritation and spasm of the respiratory tract. In many the eyes smarted and ran with water. Very soon the toxic effects of the gas showed themselves in headache, with a sense of weakness in the legs, and such lassitude that the men dropped prone upon the ground, the spasmodic violence of their respiratory efforts being largely quietened. In this posture they lay in still greater danger, since the heavy gas clung in more poisonous concentration to the trench bottoms and recesses of the ground. The throat burned, and the dry mouth produced an intense sensation of thirst. Retching was at once experienced by some, but many did not vomit until an hour or two later, when a draught of water caused yellowish fluid to be brought up, with a considerable sense of relief. Irritation of the trachea resulted in severe pain behind the sternum, which soon radiated outwards on each side into the chest, and added greater suffering to the distressed breathing.

Stumbling through the gun-fire, and half stupefied, most of the men reached shelter and medical aid behind the trenches, where many of them lapsed into a state of semi-consciousness. Those who died on the field were greenish-white in the face, not blue.

No post-mortem examination has been made on any such case of early death.

2. **Second to Fifth Day.**—Consciousness was now, as a rule, restored. The vomiting and the violent cough had ceased. The appearances presented by the most severe cases were those of the deepest asphyxia. The congested face was of a violet-red colour, the ears and finger-nails livid. The arteries were distended, with a full pulse at a rate of less than 100. The breathing was shallow and extraordinarily rapid, up to 60 or even 80 in the minute; but the movements were effected chiefly by the diaphragm and accessory muscles at the upper inlet, the chest itself being held in a position of utmost distention. Everywhere the percussion note was resonant, even over the bases, which autopsy proved to be almost solid with œdema; and the breath sounds were harsh, and accompanied by numerous fine crepitant râles. In the first day there was a profuse expectoration of a yellow, highly albuminous fluid, which was sometimes so abundant that it ran from the patient's mouth when the stretcher was tilted head downwards. Later this subsided, and was replaced by a viscous primrose-yellow sputum, which was often streaked with blood from tracheal hæmorrhages, or stained reddish-brown when it came from infarcted areas within the lung.

Despite this hurried breathing, the sufferer complained more of pain in

the throat, chest, and epigastrium than of shortness of breath; and he preferred to sink down in the bed rather than sustain the effort of sitting propped up. The lips were parched, the roof of the mouth glazed, and the tongue so heavily coated with a brown, dried fur that several patients repeatedly scratched the inside of their mouths with their finger-nails to remove the "leathery gluey feeling." No abnormal odour was noticed in the breath. There was frequent and shallow, but painful, cough. The temperature was raised to 100° or 101°, but the skin was dry, unlike the general state of steaming perspiration which accompanies the occasional asphyxiation of ordinary bronchitis.

Many died at this stage. Autopsy revealed the ordinary features of an asphyxial death, but with two peculiar changes in the lungs as the cause of this asphyxiation. They are disruptive emphysema and generalized œdema.

Fig. 75.—Drawing of the trachea of a patient who died thirty-six hours after having been gassed. He was deeply cyanosed, and lightly delirious. In the actual specimen the most striking feature was the abrupt line of transition (T) from the purple plum-coloured mucous membrane of the upper pharynx to the healthy pinkish-white tint of the unaffected œsophagus at the level of the thyroid cartilage. All the surfaces over which the irritant gas played are deeply injected and discoloured. There was, however, very little œdema in the trachea, and no inflammatory membranes had been formed.

Curiously, the laryngeal aperture was in most cases free from œdema and irritation. The voice rarely became hoarse, and the dyspnœa, at any rate after the first few hours, was never caused by laryngeal obstruction. This extreme congestive irritation was evident in almost all the fatal cases before the use of respirators. The protection devised later prevented this injury of the pharynx and trachea, even in men who died with inflammatory œdema of the more delicate lung tissues. [*Ref. No.* 5.]

The one bursts the alveoli, the other fills them with albuminous inflammatory exudate. Circulation of the blood through the lungs is consequently hindered, and the gaseous exchange arrested in the areas affected. Death is the result of the physical changes produced by the respiratory irritant—namely, the violent cough and spasm with its disruptive emphysema, and the later inflammatory œdema.

If the patient survived the asphyxiation of the first few days, his colour soon became normal again; but the dyspnœa persisted for some time, and a cyanotic tinge at once returned to the face when any muscular efforts were made. Mr. J. Barcroft, F.R.S., analysed the blood of several sufferers in an investigation as to whether this prolonged dyspnœa might be due to a special acidosis from an inhaled poison. Nothing was found beyond the ordinary changes due to diminished oxygen intake and carbon dioxide output: so it is probable that the dyspnœa was due partly to emphysema and partly to the

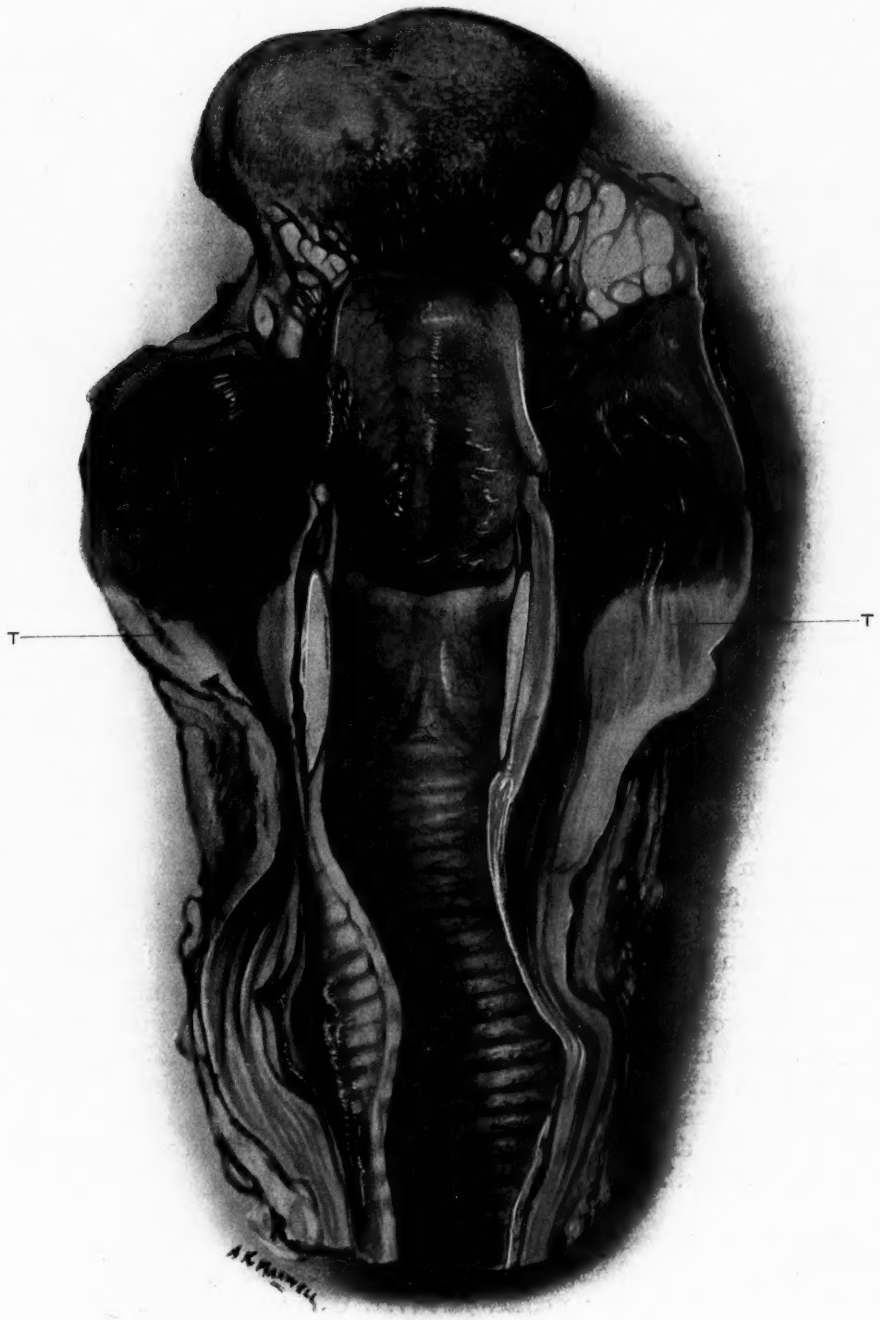

FIG. 75.—DRAWING OF THE TRACHEA OF A PATIENT WHO DIED THIRTY-SIX HOURS AFTER BEING GASSED.

T. Note the abrupt line of transition in colour from purple to a healthy tint, at the level of the trachea.

persistence of œdematous areas in the depths of the lungs, leaving a small respiratory surface which could suffice only for the gaseous exchanges of the body while at rest.

The râles vanished in a few days, and the patient then complained only of headache, lassitude, and occasionally epistaxis if he got up too early. Dyspnœa was not obvious in the later convalescence.

3. Later Period of Inflammatory Complications in the Lungs.—These complications were more frequent and fatal in those gassed before the use of respirators. As they developed, the temperature rose again, and the sputum became purulent, sometimes blood-stained, and often abundant and nummular, but inoffensive. A fine pleurisy could generally be detected on one side or the other, the œdematous râles persisted, and to these were added rhonchi in all the tubes, and the breath sounds of imperfectly consolidated lung, though never of frank lobar pneumonia. The cyanosis persisted, and the pulse often indicated progressive weakening of the heart. Some of these

Fig. 76.—Congested kidney from the same patient as shown in the previous figure. The drawing does not give the full cyanotic tint of the actual specimen, but the congested vessels are satisfactorily shown. Even in this early case there is a tendency to a yellowish appearance in the cortex, which foreshadows the very obvious features of parenchymatous nephritis that are established in men who die in the second week. A description of such a later specimen will be found in Lieut. Henry's memorandum. [*Ref. No.* 4.]

cases died in the second week, but all who survived beyond that recovered—at any rate, from the acute illness.

Out of 25 men of the 15th Canadian Battalion (Montreal Highlanders) who were seen at Boulogne after having been gassed on April 24, 3 died in the early stages from asphyxia, 3 from late bronchitis and bronchopneumonia in the second week, and 4 severe cases with secondary infections recovered. These figures, however, give an exaggerated idea of the fatality. The total mortality was probably under 10 per cent, and of the patients who survived to reach the base hospitals and yet were ill enough to be sent down, less than 2 per cent died. The actual figures have not yet been published by the army medical authorities.

The pulmonary lesions and the asphyxial hæmorrhages constitute the chief clinical and pathological features in men who have been poisoned by trench gas. Some other points, however, deserve mention. The poison is absorbed into the circulation, through which it affects the nervous system, the kidneys, and probably the stomach.

In many cases the stomach after death showed multiple petechial hæmorrhages, or even areas of wider erosion. Probably these were not altogether

FIG. 76.—CONGESTED KIDNEY FROM THE SAME PATIENT as shown in *Fig.* 75.

asphyxial, but were caused by the action of the gastric juice on a mucous membrane the vitality of which had been lowered by the circulating poison. Epigastric pain was often complained of by the men, and in some cases it was aggravated by solid food. Hæmatemesis was never observed, but in two out of sixteen autopsies the stomach was found to be full of blood.

Headache and fatigue were evidence of the poisoning of the central nervous system. The ordinary gas did not produce lasting coma. No physical signs were found to indicate localized lesions in the central nervous system, and there was no instance of peripheral neuritis. Naked-eye examination after death revealed no changes in the brain other than those of asphyxia.

Fig. 77.—Drawing of a foot with vascular obstruction caused by gas poisoning. The clinical details were as follows :—

April 24.—The patient was gassed at daybreak. He was in dry trenches, under conditions which could not possibly have induced anything resembling frost-bite.

April 27.—Admitted to hospital at Boulogne. Pulse 90. Breathing painful and rapid, 50 to the minute. Lungs full of fine râles. Face slightly cyanosed, and terminal inch of nose livid and cold. Right hand slightly mottled, cold, and painful. Both feet stone cold and discoloured. No pulsation could be felt in the dorsalis pedis artery. Immediately above the ankle vital warmth commenced, and there was slight œdema, with so much tenderness and pain that the patient could not endure the pressure of the bed-clothes on his feet. The feet themselves were quite anæsthetic. The urine contained a trace of albumin, but no sugar.

May 2.—Purulent bronchitis. Temperature 104°, respirations 36. Nose and hand normal. Feet warm, but the toes were cold and much blacker, while the area around the ankles was redder and more œdematous.

May 17.—Practically well. Discharged to England. Feet almost normal, except that a couple of toes were black and shrivelled, suggesting that the superficial tissues would ultimately separate with a dry gangrene. The condition was very like that of Raynaud's disease, but the patient had never suffered from that ailment. [*Ref. No.* 2.]

The hæmoglobin and plasma of the blood had lost none of their respiratory properties ; but owing to the uselessness of the lungs the blood was asphyxial, and clotted very rapidly after death. Three patients, none of whom died, developed a vascular obstruction in their extremities, with progressive loss of the arterial pulse. The onset of this was slow, and not of an embolic character. The limb became cold and livid, presenting an appearance very much like that seen in some cases of frost-bite. Gangrene at first seemed likely, but the circulation was soon restored and the tissues regained their vitality. In the case related below, from which the drawing of *Fig.* 77 was made, the symmetrical distribution of the vascular changes proved that they could not have been simple pressure effects caused at the time when the man may have lain out in a semi-conscious state.

FIG. 77.—DRAWING OF THE FOOT OF A PATIENT SHOWING VASCULAR OBSTRUCTION, THE EFFECT OF GAS POISONING.

The kidney lesions are of great pathological interest, but fortunately they do not appear conspicuously in the clinical picture. In all men who died in the second week, the kidneys showed the changes of a moderate acute parenchymatous nephritis, being pale and swollen. The first stage of such a nephritis could also be detected in cases of death during the first few days, when the kidney, in addition to venous congestion, showed a yellowish tint in the cortex that is slightly exaggerated in *Fig.* 76. Microscopic examination revealed a tubal nephritis in all, with changes also in the glomeruli. Yet none of them in life had œdema; only one showed uræmic symptoms; and the urine in gassed cases generally was remarkably free from albumin and casts. It remains for further study of the history of these men to determine whether such a toxic nephritis, that at its incidence is clinically so unobtrusive, is likely at a later date to cause degenerative changes in the organ. If such were the unfortunate sequel, the example would be of interest in its relationship to the general question of the etiology of chronic nephritis in civil life.

With this reservation, the prospect of a complete recovery for men who

Fig. 78.—Lung of a patient who died four days after having been gassed. Disruptive emphysema was relatively slight in this case, and there was no mediastinal emphysema. The upper drawing shows scattered subpleural hæmorrhages. The lobular reticulation marks the lines along which air-bubbles are found in the emphysematous cases. The lungs were voluminous and almost solid with œdema, so that they presented a uniformly fleshy appearance on section. From the trachea exuded a frothy serum, which was congealed to a yellowish white friable mass by the formalin preservative. [*Ref. No.* 3.]

have been badly gassed, but survived the first fortnight's illness, seems to be good. Disruptive emphysema, it must be admitted, damages the lung tissue to an extent which, in those who have died, seems almost irreparable. But it is probable that this injury is of a much less severe nature in the men who survived. Chronic emphysematous changes may make their appearance in them later, but no such unusual shortness of breath was noticed in the convalescents as would make one very apprehensive of this disability.

NOTES ON THE POST-MORTEM FINDINGS IN SIXTEEN CASES.

(By Lieut. Herbert Henry, R.A.M.C.)

The description herein briefly outlined of the post-mortem findings in death from gas poisoning, embodies observations made on a series of sixteen cases which died in hospitals at the Boulogne base. It is well at the outset to bear in mind that the description is not only an incomplete one by reason of the limited material available, but that it is also one-sided, for it deals

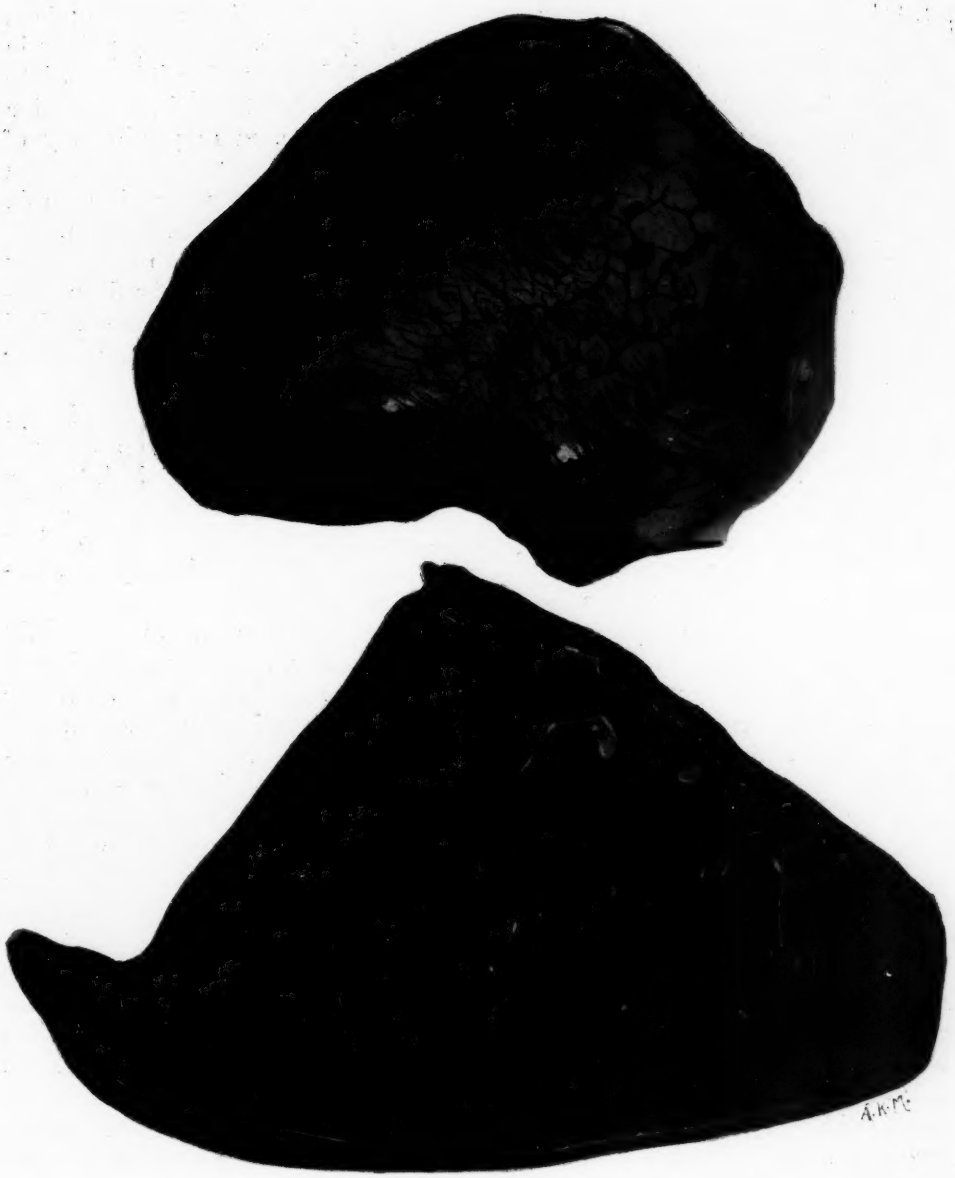

FIG. 78.—DRAWING OF THE LUNG OF A PATIENT WHO DIED FOUR DAYS AFTER BEING GASSED.

only with the two groups of cases which died of acute asphyxia or of late inflammatory complications.

Immediately after death cases which have died within a few hours or days of being gassed show varying amounts of a very fine froth exuding from both mouth and nose. It may persist for some hours, is distinctly yellow in colour, and imparts a canary yellow tint to fabrics with which it comes into contact. As it subsides, it pigments the skin, so that there is produced a yellow discoloration of varying intensity of the face, more particularly of the lips, the alæ nasi, and the inner aspect of the cheeks. Later, post-mortem mottling develops, but it is in no wise different from that which is seen in other cases, either in respect of the time of its onset or in its distribution.

On opening the thorax, the superficial veins are found to be greatly engorged with blood that has clotted early, and the muscles are of a deep dull-purple tint. There is frequently emphysema of the anterior mediastinal tissues, and this condition may spread thence to the loose cellular tissues of the neck, so that they become crepitant.

The pericardial fluid is often increased in amount, and may be bloody. There are often present hæmorrhages of varying extent under the epicardium, particularly towards the base of the heart. The heart itself is intensely engorged throughout all its cavities, and small irregular hæmorrhages may be found under the ventricular endocardium. In one instance of death after twelve days, where there was extensive pulmonary infarction, pale ante-mortem thrombi were found in both auricle and ventricle.

The changes in the upper respiratory passages, as in the lungs, vary greatly according to the time the case has lived after gassing, and also according to the degree of protection afforded by different types of respirators. Where acute irritative changes are developed in full measure, both pharynx and larynx show a deep dull-purple mucous membrane with much-dilated sub-mucous venules (*Fig.* 75). There may be œdema about the base of the tongue, round the pillars of the fauces, and in the thyrohyoid lacunæ. In one case there was found marked blackening of the dorsum of the tongue, while the lymphoid patches at its base, much swollen and reddened, showed numerous punctiform ulcers. But these appearances are probably of doubtful relationship with the general condition. Inflammatory changes vary considerably in their distribution. For instance, they may be much in evidence at the lower end of the trachea and in the bronchi, while the larynx itself may be quite clear. No case has presented hæmorrhages into the submucosa or into the peribronchial tissues, nor has any condition resembling membrane formation been seen. In early cases the lumen of the trachea and bronchi is occupied by a thin frothy serous fluid, which may be blood-stained, and which may be present in such a large amount that the individual can well be said to have drowned in his own œdema fluid. In later cases this thin serous fluid becomes viscid, tenacious, and mucopurulent.

The pleural fluid may be increased in amount, either from escape of œdema fluid into the cavity, or from inflammatory effusion due to secondary invasion from micro-organisms. The lungs are abnormally large and voluminous, showing but little tendency to collapse on removal from the chest. On the external aspect may be found numerous subpleural hæmorrhages, varying

much in size and in distribution, but more frequent perhaps along the free margins (*Fig.* 78), at the posterior surface, and on the internal lobar surfaces. Adjacent hæmorrhages may coalesce, so that the pleura is stripped up over a considerable area and separated from the adjacent lung tissue by a collection of bloody fluid. There is often to be found, too, on the external surface, evidence of ill-defined patches of collapse, alternating with patches of emphysema and with irregular areas of consolidation, the latter frequently with lymph on their pleural surfaces. Intervesicular emphysema, with rows of air-bubbles running in tortuous channels under the pleural surface, is not infrequent.

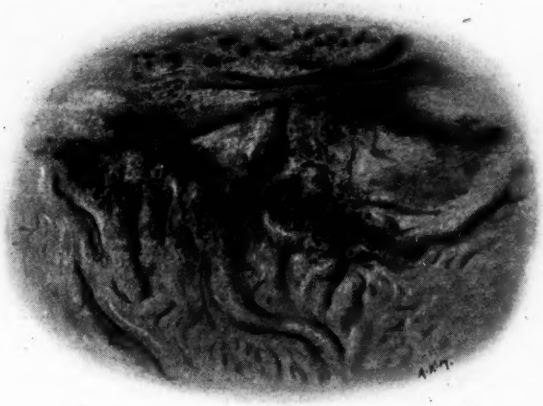

Fig. 79.—Inner surface of the stomach of a patient who died with diffuse bronchopneumonia ten days after exposure to trench gas. Numerous petechiæ are seen, and the stomach contents were mixed with blood, but there was no actual ulceration. Slight uræmic twitchings developed in this man the day before death, and his kidneys provided the example of nephritis which is described in detail by Lieut. Henry. [*Ref. No.* 4.]

On section, the lungs in early stages show intense vascular engorgement, and exhibit newly-formed patches of bronchopneumonic consolidation alternating with irregularly scattered areas of emphysema, the latter being just as frequent in the interior of the lung as on the free surface. But superadded to all these changes, and indeed the dominant feature of the whole condition, is an intense œdema, and it is perhaps this appearance more than any other which must be looked on as characteristic. Later, the œdema tends to subside, while the small indefinite plum-coloured areas of consolidation coalesce and become more well-defined greyish-yellow patches of bronchopneumonic consolidation. Large pieces of lung, when placed in water, float just level with the surface of the fluid, but it is easy to dissect out pieces which

sink completely. Also, there are found at times lung infarctions of moderate size; or there may be produced a uniform consolidation resulting in complete hepatization. According to information received from the French Gas-Poisoning Commission, one case at Calais developed lung gangrene at the end of three weeks.

Broadly speaking, œdema of the lungs with asphyxial signs is characteristic of the earlier stages of the condition, whereas in the later cases broncho-pneumonic and pneumonic consolidation are more in evidence.

The stomach often shows submucous hæmorrhages, limited it may be to the cardiac and to the pyloric end, but often diffusely scattered over the whole viscus. Hæmorrhages may be so extensive that the stomach and duodenum are filled with black digested blood.

The spleen is enlarged, hard, and firm. Early on, the liver is enlarged, friable, and full of blood, but it soon develops the nutmeg appearance due to prolonged passive hyperæmia.

The change of most interest, perhaps, in the abdominal organs is that which occurs in the kidneys. Kidneys obtained from early cases show nothing more to the naked eye than intense cyanosis, but there is microscopic evidence that such a kidney may show early nephritic changes. In at least one case, and probably to a lesser degree in others, these changes had progressed so far as to give the complete picture of an acute nephritis. The kidney of the patient referred to in the description of *Fig.* 79 (death after ten days) may be thus described: It is enlarged and pale in colour; the stellate veins are prominent; the capsule is thin, tense, and strips easily. On section, the cortex is of a dull greyish-pink colour, much wider than normal, and its striations are indistinct, while scattered throughout are small brownish-red points showing the position of some of the glomeruli. The intermediate zone is of a greyish colour, and the pyramids are paler than normal. Microscopically, it shows intense nephritis involving both the glomeruli and the tubules.

HÆMOTHORAX.

By Col. Sir JOHN ROSE BRADFORD, K.C.M.G., C.B., F.R.S., A.M.S., and Capt. T. R. ELLIOTT, F.R.S., R.A.M.C.

Wounds of the chest in warfare may sometimes cause extensive laceration of the lung or of the chest wall without producing a hæmothorax. Such cases are excluded from discussion in this paper, which deals only with the occurrence of a hæmothorax.

The two main questions which arise when a medical officer has to deal with a man who has been wounded in the chest are questions which turn upon the dangers of prolonged bleeding and of sepsis. How soon can the soldier be evacuated to the base hospitals? A delay of several days must be interposed at the earliest possible resting-place on the evacuating line if there is a real risk of movement augmenting the internal hæmorrhage to an extent that may be fatal. What is the probability of sepsis? Is the hæmothorax likely to be infected and soon become an empyema, and is there a risk of the introduction of sepsis if an attempt is made to aspirate an uninfected hæmothorax?

The experience gained in the South African War inclined surgeons to a most conservative method of treatment. Movement was naturally deprecated when the journeys from one point to the next on the line of communications were so long and trying to the patients. Infection of a hæmothorax was a rarity. Sir George Makins, in his book on *Surgical Experiences in South Africa, 1899–1900*, states that during the whole campaign he saw only a single case of primary empyema, and this was one which he attributed to infection introduced in an early operation for the removal of a bullet as it lay beneath the skin. On the other hand, secondary empyemata were supposed to have been caused in several instances by aspiration; and there was a general belief in South Africa that aspiration was useless in addition to being dangerous, since the fluid was observed to have accumulated again after the first tapping. Aspiration, therefore, was condemned. Resection of a rib in order to dislodge intrapleural blood-clot was also, and rightly, forbidden, since secondary infections were then certain to be introduced. Primary empyemata did not exist. So it was decided that chest wounds were best left to the natural processes of cure: and the cases recovered very well.

The present campaign in Flanders has changed this teaching. High-velocity bullets at short range, or tearing fragments of shell, cause greater laceration than was seen in Africa, and the effusion of blood into the thorax is often so large in amount that it cannot very well be left alone. The clothing and the skin of the soldiers are fouled with soil and fæcal organisms, and from this source primary infection is very frequently introduced into the hæmothorax. Hæmorrhage would appear to be, and sepsis most undoubtedly is, a much more serious matter in the prognosis of chest wounds than it was when our Army was last in the field.

The clinical material upon which the conclusions embodied in this paper are based was abundant. Thanks to the courtesy of the officers of the R.A.M.C., all the cases of chest wound that passed through Boulogne from the first days of November onwards were made accessible to us for study. During this time the base hospitals in Boulogne were about sixty miles from the front, and the journey down by ambulance train from railhead took about twelve hours. Many chest cases arrived on the second or third day after the wound had been received, though others were delayed at some point nearer to the front until the end of the first, or even of the second, week. Until the summer, all convoys, even those destined for most distant bases, passed through Boulogne, and it was the rule for the worst and the moribund cases to be picked out of the trains and left at this town. During this time, therefore, the hospitals grouped around the railway station at Boulogne received the worst wounds, and provided the best opportunity for a study of the fatal results that might follow from an injury of the chest.

Cause of Death. — The figures which we quote were collected in two different ways. In the first place there is a group of results derived entirely from post-mortem examinations. Autopsies were made by Dr. H. Henry on all cases of chest wounds from two hospitals, and also on several cases which had died in transit on the trains. Many of these were never seen by us during life. In addition to the chest wounds, Dr. Henry was engaged in a routine examination of deaths from paraplegia, which naturally included a considerable number of cases with hæmothorax as well, the missile having traversed the lungs to reach the spinal cord. The following are his results :—

Post-mortem examinations were made on 84 bodies with chest wounds. Of these, 69 had an effusion of blood into the pleural cavity. In this group of hæmothorax, 23 died of complications, such as purulent bronchitis, paraplegia, or additional injuries to the abdominal viscera. The remaining 46 died simply from the hæmothorax. But the effusion was found to be infected in 38 of this number, and death in every single one of these had been caused by the infection. Only with certainty in one man, who died on the third day, and perhaps in 7 other doubtful cases where the evidence was incomplete, could the death be ascribed to simple hæmorrhage. Yet many of these 46 men succumbed within the first week of their injury.

From this the conclusion is quite clear. Death from simple hæmorrhage is not to be feared if the patient has survived to the third day ; nor does removal to the base introduce any further danger in respect of hæmorrhage after that date.

The second group of statistics is of a different nature, for it comprises only those cases which were seen during life. In this series clinical notes were taken by one of us (T. R. E.) of all those cases which are included in the numbers given. But for this very reason the figures are a little misleading ; because, as the work increased in volume, it soon became impossible to keep records of the mildest cases, in which the effusion of blood was small or non-existent. These were dropped aside, and in consequence the proportion of severe to mild cases is unduly high. No case is described as septic unless an infection was proved to exist by bacteriological examination. The clinical notes fell into two groups : (*A*) from November to the week of Neuve Chapelle

in March, during which a fair proportion of even the mildest cases were noted down; (*B*) from March to July, when only the severe cases were as a rule recorded.

Group *A* gave a total of 168 cases of hæmothorax. (There were also notes of 27 in which the lung was wounded but there was no effusion.) The hæmothorax was sterile in 114 cases, and 48 of these were so large (generally forty ounces or more) that they had to be treated by aspiration. There were 28 infected cases which survived after resection of a rib. Death occurred in 26 cases with effusion, and in 20 of these death was due to sepsis, only 1 having died, on the third day, as the direct result of simple hæmorrhage from the lungs. The aggregate is 48 septic as against 120 sterile effusions, of which 48 were large.

In group *B* sepsis is still more prominent. The total was 160 cases of hæmothorax. (In this group only 5 cases of simple wound without effusion were noted.) The hæmothorax was sterile in 86 cases, and of these 41 were aspirated. There were 53 septic cases which survived after resection. There were 21 deaths, and in 16 of these the effusion was septic. There was again only 1 death from simple hæmothorax, and that was complicated by a wound of the heart. The aggregate is 69 septic as against 91 sterile effusions, of which 41 were large.

The entire total gives 328 cases of hæmothorax; 211 were sterile, and 89 of these were so large as to need aspiration. Sepsis was found in 117. Death occurred in 47 cases, of which 36 were septic. Only in 2 deaths was simple hæmorrhage the cause. Infection, therefore, was present in roughly one-third of the cases recorded, and the large effusions were just as often septic as sterile. To obtain approximate percentage figures, one might allow for mild cases of hæmothorax which were seen but not noted down, raising the total to about 450. *Infection would then have been found in* 25 *per cent, and the total mortality for all cases would be* 10 *per cent.* As regards the cause of death in this mortality figure, it was actually found that 70 per cent died from sepsis, 5 per cent from simple hæmorrhage, and the rest from sundry complications.

This death-rate applies only to hæmothorax, and it represents the incidence in a group of base hospitals to which the severest cases tended to be sent. In the casualty clearing stations nearer the front an almost identical mortality of 10 per cent has been recorded, but this is the death-rate of all wounds of the chest, and it covers chiefly the mortality in the first few days after the wound. No autopsies could be made to determine the actual cause of death in these men. It may be presumed that simple hæmorrhage, the chief cause of death on the field, also claimed a share of the 10 per cent who died near to the front. In the 10 per cent mortality among the survivors who passed through the casualty stations and reached the base, hæmorrhage was negligible, and sepsis took its place as the chief danger to be feared.

The chance of infection has therefore to be considered in every case of hæmothorax. It may develop as acutely as an infective peritonitis, and with almost as rapid a movement to a fatal end. Hence comes the importance of moving the wounded man as soon as possible, after the danger from hæmorrhage has passed away, to a station where the infection can be promptly recognized and dealt with.

STERILE HÆMOTHORAX.

The Effusion.—Post-mortem evidence has shown that in some of our cases the blood came from the vessels of the chest wall, in others directly from the lungs. The exact source cannot be determined in life, and therefore every case should be treated as though the blood had been derived from the lung. Hæmoptysis, early or late, occurs in a great majority; but it cannot be relied upon as a token of the source of the hæmothorax, for it may be merely the result of a bruise of the lung from an extrapleural wound; while on the other hand it has even been absent in some cases where the lung was wounded and the bronchi were ultimately found to contain much blood. The track of the missile through the lung rarely shows much laceration, but there is considerable infarction around it. The missile generally passes right through the soft tissue and is arrested elsewhere.

The bleeding is in all probability fairly rapid, though not often so abundant as to cause faintness in the cases that survive, and the leakage soon comes to an end. Though we saw ten cases within a few hours of their wounds, and a considerable number on the second day, it was only rarely that we met with evidence of a prolonged, or of a late resumption of, hæmorrhage.

There has been much discussion as to the extent to which the effused blood coagulates inside the pleural cavity. Post-mortem evidence is a little unsatisfactory, on account of the clotting that may occur after death. The material that is removed by aspiration from a sterile hæmothorax at any time from the fourth day onwards may be :—

1. A brownish-red fluid, which yields a light gelatinous clot *in vitro* on standing, and contains lymphocytes and endothelial cells. The fluid which separates from the clot is generally tinted by the products of hæmolysis, but it may be a clear transparent yellow.

2. A deep-red fluid, exactly like non-clotted blood, which, however, throws down a very heavy deposit of ordinary red cells on standing, and may fail to give even the lightest of clot *in vitro*.

3. Masses of soft blackish clot, like jelly, which soon block the needle.

In two cases of aspiration on the sixteenth day, a dark-red fluid was obtained which clotted *in vitro* to a solid mass. At first the opinion was that in these two examples the blood had remained unclotted in the chest, while still retaining its normal coagulability on removal. Then it became necessary to admit that in (3) the ordinary processes of clotting must have already taken place within the chest; while (2) was explained by the hypothesis of some peculiar change in the contrary direction which rendered the blood non-coagulable. These contradictions can be avoided by the explanation which is given by Elliott and Henry. From their observations, it appears probable that clotting takes place always—and very early—through the action on the blood of the ferment liberated at the surface of the wounded tissues. The clot may be (*a*) complete and massive, forming a soft and persistent clot, such as is found in (3); (*b*) massive, but with an early and fairly extensive separation of the yellow serum from the clot, as in (1); (*c*) interfered with by the churning movements of respiration, so that the fibrin is whipped out in layers which cover the pleural surfaces, while the serum retains most of the red

corpuscles in suspension, precisely as is seen with defibrinated blood in a test tube. This corresponds to the state of (2), and the correctness of the explanation is borne out by the observation that aspiration fluids of this class have been found by direct test to be devoid of fibrinogen.

The pleura reacts to the presence of the blood by a mild inflammation, with a consequent emigration of endothelial cells, lymphocytes, and of polymorphonuclear leucocytes, and with an outpouring of a variable amount of inflammatory fluid which contains fibrinogen, and therefore yields a *secondary clot* outside the body when the fluid is allowed to stand after aspiration. This secondary gelatinous clot resembles that of an ordinary pleural effusion, and it may even be so dense as to mimic a primary clot.

According to this view of an early coagulation within the chest, the point of leakage will soon be sealed by clot. Post-mortem examinations, indeed, often reveal such a condition, with a layer of compact fibrin adhering to the pleural surfaces and closing the wound, while the cavity is occupied by a red 'whipped' blood which does not clot on standing. The clot tends to lie in masses at the back of the chest and along the paravertebral recess. The lung itself is collapsed by pressure where it dips into the hæmothorax. Above this it is over-distended and emphysematous, so that the upper lobe may actually encroach across the middle line of the chest as the whole mediastinum is displaced laterally by the increase of intrapleural pressure due to the effusion. The largest effusions of 70 to 90 oz. generally cause complete collapse of the entire lung against its root; but at times the collapse may be rendered asymmetrical by the tethering action of old pleural adhesions.

Subcutaneous emphysema is fairly common in these penetrating wounds, and it is difficult to believe that this can develop without some air being also driven from the lung wound into the pleural cavity. Perhaps small collections of air may be frequent, for it is very difficult to prove or disprove their presence by the ordinary methods of physical examination. Large collections of air together with blood, causing complete collapse of the lung, are undoubtedly rare. In the total series of 328 cases of hæmothorax, only 8 indubitable examples were met with, while there were in addition only 4 cases of complete pneumothorax without blood.

Clinical Features.—The physical signs are as follows: The chest on the side of the hæmothorax moves poorly, the intercostal muscles in the lower half and the diaphragm being largely out of action. The diaphragm remains in a state of atonic relaxation, so that the area of stomach resonance is found to extend unusually high on the left side. This immobility is not caused simply by the wound of the lung, for it only appears with a hæmothorax. The heart is displaced away from the effusion. This displacement is greatest in the first two or three days, before the chest becomes quite immobile, and while the lung has not yet reached its fullest degree of collapse. The percussion note is dull, high-pitched, and resistant over the effusion. Above this, over the emphysematous upper area of the lung, the note is often of a lower pitch and more tympanitic than over the corresponding area of lung on the other side, this Skodaic resonance being at times exaggerated to a surprising degree. The presence of subcutaneous emphysema is at once recognized on palpation, and it introduces a very tympanitic note on percussion which completely

masks the condition of the deeper strata. Tactile fremitus is abolished over an area slightly less than that of the dullness on percussion. It is often increased over the area of Skodaic resonance; and it is only weakened, not abolished, over the air in a pneumohæmothorax. The breath sounds are generally weak over the emphysematous area, very weak and distantly tubular over the dull area. But sometimes the tubular sounds from the collapsed lung within a hæmothorax are so loud and clear as to suggest, quite wrongly, that the lung is close to the thoracic wall. Adventitious sounds, putting aside those due to subcutaneous emphysema, are rare on the injured side. The vocal resonance is always changed: over the Skodaic area it is increased to a loud buzz; over the fluid the buzz is lost, but there may be bronchophony and whispering pectoriloquy, while ægophony is frequently heard in areas which change from day to day.

At the moment of the wound, the soldier often feels completely winded, and this distress is succeeded by a dyspnœa which lasts for two or three days, or as long as there is a large effusion inside the chest. Hæmoptysis generally occurs, but it is rarely abundant, and it does not often show the colour of fresh bleeding after the first week. The temperature rises to 101° or even 104° in the first few days. After that the chart varies with different cases. In the majority the temperature soon falls nearly to normal, oscillating from 98° to 100° for the next week or two. But in others it may remain high, or rise again after a preliminary fall. A high level is rarely shown, and the rule is to see regular daily oscillations from 99° to 102°, or from 100° even to 104°. No satisfactory cause has been found to explain the difference between these types. The temperature has nothing to do with the state of clotting of the effused blood; and no recognizable micro-organisms have yet been found in the febrile cases which run an aseptic course.

The tongue is clean or lightly furred. The blanching that would be expected from a loss of 60 or 70 oz. of blood is not manifest. Indeed, after the second day the patient does not exhibit the picture of internal hæmorrhage. A very faint icterus may appear towards the end of the first week as the result of absorption from the hæmothorax, but there is never real jaundice. In the second week, the patient feels and looks well, and his face soon regains the aspect of health. Even the largest effusions do not prevent his breathing with fair ease in the recumbent posture.

Differential Diagnosis.—*Pneumonia*, presumably of traumatic origin, is sometimes diagnosed in mistake for the hæmothorax. The opinion rests upon the combination of fever, dyspnœa, and tubular breath-sounds, together with loss of movement on the wounded side. These mimicking physical signs are due to the extreme collapse of the lung, and they form a group closely resembling those which occur in the massive collapse of the lung that may follow an abdominal operation in civil life, where they are also very frequently misinterpreted as being due to pneumonia. The points that prove the hæmothorax are the displacement of the heart, and the absence of fine crepitations. Pneumonic consolidation does occur occasionally in the contralateral lung, and this complication adds to the fever of the hæmothorax. But we have never found unequivocal proof of its occurrence on the side of the hæmothorax. The mimicking signs vanish rapidly when the

lung is expanded by aspiration of the compressing fluid. Moreover, it has been a striking feature in post-mortems that the collapsed area is generally free from invasion by such secondary inflammations as may have beset the rest of the lungs.

Pneumohæmothorax is a wrong diagnosis that is sometimes made when the emphysematous upper part of the lung above an effusion gives a tympanitic percussion-note and weak breath-sounds. In most cases these changes are Skodaic phenomena, as is proved by the increase of tactile fremitus and of vocal resonance in association with them. In addition, the *x* rays show a radiogram in which the opaque blood has an irregular and slanting upper margin. Where air is present in considerable quantity above fluid, the upper level, as the patient sits erect, is strictly horizontal, and undulatory oscillations can readily be observed in the fluid by the fluorescent screen. This test is decisive, and it can always be applied, because the clotting in a large pneumohæmothorax, by reason of the greater churning movements, is of the type that yields a fluid 'blood.'

Spreading Collapse.—In an article published a little more than a year ago in this JOURNAL (Vol. I., p. 587), Dr. W. Pasteur described the nature of what he styled "Massive Collapse of the Lungs in association with Abdominal Lesions." In the cases under discussion by him the lung had collapsed during a phase of inadequate respiratory movements, though there was no cause to produce an increase of intrathoracic pressure.

In four quite definite instances we have met with a change which is somewhat comparable to massive collapse. A man's chest is found to be dull to the clavicle, and the signs are those of a very large hæmothorax, except that the heart is not displaced. In a few days the dullness clears up, and the residual signs are only those of a small effusion at the base. We have obtained radiograms illustrating the change. The patients had neither fever nor much purulent expectoration. The probable explanation is that, with imperfect respiratory movements, the usual contrast between collapsed lung below the effusion and emphysematous lung above it is lost, and the state of collapse spreads over the entire lung. Changes of a similar nature, but less extensive, no doubt often occur during the adjustment of a lung to the presence of a hæmothorax, and they are likely to lead one astray when attempting to decide by physical signs whether an effusion has increased or diminished in size. Their clinical importance is that, in the exaggerated examples, they may lead to the wrong opinion that the patient has bled afresh, or that the effusion is so large as to require relief, though it really is small. The criterion is given by the displacement of the heart.

Septic Hæmothorax.—So soon as it has been ascertained that a hæmothorax is present, the question arises whether the blood is sterile or infected. The answer may require an exploratory puncture of the chest, and the evidence obtained in this way will be discussed on a later page.

Complications.—Those caused by wounds of other organs in addition to the lungs are generally so obvious that they do not need discussion here. On the right side the liver is frequently injured. Such an injury does not cause jaundice, unless it is accompanied by free bleeding into the peritoneal cavity. In one case under our observation a biliary fistula into a closed hæmothorax

was caused by a bullet wound. The bile was secreted abundantly, but it remained sterile, and the internal fistula closed in about six weeks, after fifteen pints in the aggregate had been removed by successive aspirations.

Grazing wounds of the heart are probably the cause of a pericardial friction that is often heard when the track of the bullet has gone near the heart and yet there is no infection. This friction may persist for many days, but it is not of any grave importance. No case with a large hæmopericardial effusion has, to our knowledge, survived to reach the base hospitals.

Other complications are those caused by infective processes within the lung itself. The bruising and laceration of the lung around the track of the bullet rarely leads to the development of infected areas, except in cases with paraplegia, and the lung soon heals. But a few cases of laceration without hæmothorax were met with, in which a gangrenous pneumonia spread rapidly from the wound and was quickly fatal. Purulent bronchitis of a peculiarly severe type was a familiar malady among unwounded soldiers during the winter fighting. There was no reason to think that this appeared in especial frequency in men with chest wounds; but, when it did occur, the combination of purulent bronchitis and hæmothorax was one always fraught with great danger. Pneumonia on the other side was an occasional complication, but only once fatal. The other inflammatory complications were, as a rule, secondary results of primary infection of the hæmothorax, and will be mentioned later in that connection.

Treatment.—The presence of a sterile hæmothorax may disable the patient by prolonged fever, by dyspnœa, or by a progressive collapse of the chest wall on the affected side. The lining layer of blood-clot retards absorption, and a long time must elapse before the compressed lung regains its full expansion. For this reason the free fluid should be removed by aspiration in all cases of effusion which exceed 20 or 30 oz.—that is, roughly, those in which the dullness reaches half way up the scapula. The result of this operation is that the fever disappears either at once or in a few days, the breathing becomes easier, and the mobility of the chest is regained in a few weeks. Out of 89 sterile effusions that were aspirated by one of us (T. R. E.), effusions which were chiefly about three pints in volume, there was in no case any evidence of later hæmorrhage or of any gross re-accumulation of fluid; and only in one instance, to our knowledge, did an empyema develop afterwards. The later history of these men in England has been traced in about one third of the number of cases.

The presence of clot is always liable to hinder the aspiration; and this clotting within the chest occurs so early that it is impossible to attempt removal of the blood before it has taken place. There is, therefore, no advantage in an early aspiration, and from the seventh to the tenth day is a convenient time to choose, provided that fresh hæmoptysis has ceased. Unfortunately there are no physical signs known which will serve to indicate whether the blood is congealed in a massive clot that will render aspiration fruitless, or whether the serum is satisfactorily separated. The massive clot is uncommon. To avoid trouble from dislodged thrombi in the cannula, the needle should be introduced well forward in the axilla at the anterior limit of the effusion, and high up on account of the elevated position of the diaphragm.

Owing to the great difficulty in arriving at a decision on clinical grounds as to whether the hæmothorax is sterile or infected, a sample of fluid should always be removed at the aspiration for bacteriological study; this can be readily done with the syringe that is used for the local anæsthetic.

There are two disadvantages which may attend a too rapid withdrawal of the fluid. The intrathoracic pressure in these cases may be from 10 to 20 cm. of water higher than normal. A sudden lowering of this by complete aspiration might conceivably cause fresh bleeding from the lung. Actually it is often found to inflict considerable distress on the patient, through a violent fit of coughing, or by inducing acute localized pain, or an indefinable and unbearable sense of tightness in the chest. Pain is occasionally produced when a relatively small quantity of fluid has been withdrawn. This may occur when the pressure has been lowered by only a few centimetres, and it is then probably due to the pull on adhesions around the internal wound. In other cases a high negative pressure and corresponding discomfort are soon reached because the hæmothorax is chiefly in the clotted state and only a little fluid has separated for aspiration.

All these inconveniences may be abolished by the introduction of oxygen so soon as discomfort is noticed. By alternately aspirating the fluid and injecting oxygen, it is possible to empty a chest of all the fluid without causing pain. The oxygen is absorbed in the course of a fortnight. This method of oxygen replacement has been used for some years in the ordinary effusions of civil practice, and an account of the technique has been given by Morriston Davies in this JOURNAL (Vol. I., p. 9). It is even more useful for a hæmothorax. The simplest of apparatus, without a manometer, will suffice; and the gas is adequately sterilized by passage through a bacterial trap formed by three narrow loops on an open glass tube, the inner surface of which remains wet after boiling. We always made use of Parry Morgan's excellent apparatus, though it is needlessly complex for this particular purpose.

One may repeat that with ordinary care for asepsis the process of aspiration will never infect a hæmothorax. Those which develop empyemata were infected by the original wound, and the infection can be at once detected when the aspirated fluid is examined with the microscope.

SEPTIC HÆMOTHORAX.

The figures given on a previous page show that a primary infection is so frequent in this war that every hæmothorax with fever must be suspected of sepsis.

Dr. H. Henry studied the bacterial infection in all the septic cases of our series. He found the *Pneumococcus*, *Micrococcus tetragenus*, and *B. influenzæ*, the denizens of the respiratory tract, in about 20 per cent. The remainder had all been infected from the skin or from fragments of clothing carried in by the missile. These external infections fell into two main groups—those caused by the streptococci and staphylococci, and those due to anaerobic gas-producing bacilli of fæcal origin. The latter, either pure or mixed with cocci, were found in nearly half of the infected cases, and as will be seen later, their presence is responsible for a very characteristic clinical picture.

It has been urged that shell wounds are far more liable to be septic than those from a bullet. There is a preponderance of sepsis in shell wounds, since jagged fragments of casing are almost certain to carry material from the surface into the depths of the tissues; but the difference is not great enough to enable one to use it in estimating the chance of sepsis in any particular case. In 190 sterile cases of hæmothorax, there were 121 bullet, 55 shell wounds; in 77 septic cases which lived, there were 33 bullet, 38 shell wounds; in 35 septic cases which died, there were 14 bullet, 18 shell wounds. Half of the shell wounds, and rather more than a quarter of the bullet wounds, caused a septic hæmothorax.

Whenever a sinus remains open for long, and air and blood leak to and fro through it from the pleural cavity, the hæmothorax invariably becomes infected from outside. Inasmuch as in these cases the movements of respiration do undoubtedly suck infection into the pleural cavity, it might fairly be urged that many of the examples of septic hæmothorax with a closed wound were caused, not by a primary contamination from dirt carried in by the missile, but secondarily and later through a channel which subsequently became closed. If this explanation were true, then, since movements of transport augment the dyspnœa of these patients to a considerable extent, it might be expected that sepsis would be found in a higher percentage of the men who reach the base on an early date after their wound than in those transported later. Actually there is no such difference. Of 136 cases of sterile hæmothorax, 73 arrived at Boulogne on the third day or earlier, 30 on intermediate days, and 33 on the seventh day or later; of 65 septic cases which survived, 27 arrived on the third day or earlier, 14 on intermediate days, and 24 on the seventh or later; of 28 septic cases which died, 12 arrived on the third day or earlier. These figures prove that early transport did not increase the incidence of infection; and they suggest that the septic cases became ill at so early a date that on clinical grounds they were probably separated from the rest and delayed longer at the clearing stations.

The contaminating organisms are introduced into the hæmothorax either together with the missile, or later by insuction from an open sinus, or from the respiratory tract. Since the blood clots rapidly after effusion, those entering with the missile may chance to be completely buried inside clot. The others will as a rule be rapidly disseminated through the free fluid. But inasmuch as the pleura is coated with clot, there will often be an interval of many days before pus cells emigrate from the inflamed surfaces in sufficient number to make the hæmothorax frankly purulent. During this interval the microbes may be multiplying freely in the fluid and hæmolysing the red corpuscles; or they may be shut off inside clot, so that their free escape is delayed. It is important to realize the fact that the pool or marshy collection of dead blood may be heavily infected and yet almost free from pus, so that to the naked eye its appearance raises no suspicion.

Clinical Features.—The clinical features which suggest infection are enumerated below. It will be evident, from the saving clauses which follow each item, that no single feature, nor even the complete combination of all of them, is adequate to justify on clinical grounds a certain opinion that infection is present. All may be imitated by a sterile hæmothorax, and the ultimate

proof can only be obtained by exploratory puncture and bacteriological examination of the fluid.

1. Fever, developing progressively, or sustained at a steady high level, or with widely irregular excursions of temperature. A sterile hæmothorax may be accompanied by fever lasting as long as three weeks, but the daily oscillations then, as a rule, show a regular uniformity.

2. A rapid pulse of 100, 120, or even higher. But severe infection may be present with a pulse of only 80 or 90.

3. Dyspnœa, which is out of proportion to the physical signs, and increases instead of diminishing.

4. A furred tongue, which tends to be dry and brown with the streptococcal infections. The anaerobic bacilli do not influence fur on the tongue.

5. Sleeplessness. Mild delirium marks a grave and usually hopeless infection.

6. The appearance of pain and tenderness in the side as the pleural inflammation develops. That caused by fractured ribs or by subcutaneous emphysema must be excluded.

7. Vomiting invariably means that abdominal organs have been injured as well as the lungs. But diarrhœa of an offensive nature, and presumably of toxic origin, is occasionally seen as a late result of a septic hæmothorax.

8. The development of a contralateral dry pleurisy or of a pericarditis. Pleurisy is occasionally present though the hæmothorax remains sterile. Pericarditis is a rare complication of a septic hæmothorax, while pericardial friction is often caused by a small, sterile hæmopericardium.

9. The physical signs of a septic hæmothorax in themselves do not differ from those of a sterile effusion, except in the cases where anaerobic bacilli are present. These cases are numerous, and they offer some features which require special description. The signs are caused by the slow or rapid development of malodorous gas as the bacilli grow in the effused blood: (*a*) The heart may in a couple of days undergo a great increase of displacement. (*b*) Over the bubble of gas, and within the area of dullness due to the hæmothorax, there is heard a peculiar 'cracked pot' note on percussion; this is lower in pitch than the tubular note that is sometimes elicited over compressed or solid lung, and the distinction is further aided by the fact that breath sounds are absent over the first and audible over the second. The sign is sometimes mimicked by the tympanitic note of a distended colon or stomach, heard at an unusually high level on account of the relaxation of the diaphragm. Inasmuch as the gas may develop rapidly at any time after the third or fourth day, and the patient in consequence may show great respiratory distress and collapse without high fever, these cases are liable to a disastrous error in diagnosis, which regards them as an increasing pneumohæmothorax that can only be saved by rest and morphia.

The features named above may raise the suspicion of infection, a suspicion which should be entertained in every case of hæmothorax where the general condition has not definitely improved by the *fourth* day after the wound. They cannot confirm it, and the decision is only attained by use of the exploring needle. Infection in the sample is proved by:—

1. A heavy deposit of pus on standing. Microscopic pus is insufficient proof, since it may be met with in a sterile effusion.

2. An extremely offensive odour, like that of rotten eggs or fæces, which is invariably due to the presence of anaerobic gas-producing bacilli.

3. The detection of organisms, either in a direct film or on culture. These may be found though the fluid resembles perfectly sweet blood; and, indeed, the worst streptococcal cases generally yield in the early days a fluid of a rich red colour, owing to extreme hæmolysis of the red cells.

The occlusion of organisms within a mass of clot will sometimes introduce difficulties in their detection when the chest is explored at an early date and before the free fluid is infected. This was so frequently the case with the anaerobic gas-producing bacilli, that it appeared probable that the delay might be due to some additional factor governing the rate of their growth in the blood. In nearly 20 per cent of the infections by these bacilli the bacteriological report on the first sample of fluid, removed on the fifth or sixth day, was that it was sterile. Yet all these cases appeared clinically to be septic, and a second exploration three or four days later found, as a rule, abundant infection. An extract from a case may be quoted which illustrates the steps of this pathological process.

**6*th day*.—Signs of moderate hæmothorax. *X* rays showed fragment of shell close to tenth rib.

**8*th day*.—Pulse rapid, but temperature only 100°. Chest explored: clear, yellow serum, with fine spider-web secondary clot, a few polymorphs, and no organisms.

**11*th day*.—Looks septic. Aspirated: only 15 ounces of reddish serum, with dense secondary clot, a very slight deposit of pus, and here and there a *Bacillus perfringens*.

**15*th day*.—Resected. Capt. Kelly found the shell fragment lying in a purulent pocket of offensive clot, while this in its turn was enveloped by old soft blood-clot. Rapid recovery.

Differential Diagnosis.—In a febrile case of hæmothorax this will in the first place be concerned with excluding purulent bronchitis, contralateral pneumonia, or septic wounds elsewhere as the cause of the ill progress of the case; and in respect of the hæmothorax itself, it will rest with the exploring needle to decide whether this is septic or sterile, and whether an apparent pneumohæmothorax is or is not caused by gas-producing bacilli.

Treatment.—Early recognition of infection is important. The case should not be allowed to drift on until the effusion assumes an obviously purulent character. Delay in the removal of the infected fluid reduces the patient's strength; it causes more lasting injury to the chest, through the greater thickening of the inflamed pleura; and it may even be fatal, by allowing the infection to develop into a septicæmia, or to spread into a contralateral empyema and pericarditis.

The infected fluid may be removed by aspiration. This leaves infected clot behind, and suppuration with a fresh accumulation of fluid goes on indefinitely. Some forms of infection by anaerobic bacilli may die down in a few weeks; but the probability is much greater that the patient himself will die first, if the infection is not given free exit. In the first months of the war we endeavoured to postpone opening the chest, and tried in a few cases to treat the infection by repeated aspirations. None recovered fully until a rib was resected, and the mortality in the septic cases was higher than at a later time,

when it became the routine to explore every suspicious case and open the chest as soon as infection was proved. The figures to which reference has already been made illustrate the disadvantage of tardy treatment. In group *A*—that is, up to March—20 septic cases died and only 28 recovered; perhaps 11 of these deaths might have been avoided. In group *B*, 53 septic cases lived and only 16 died; of the latter all but three or four were hopeless infections.

There may be reasons to delay operation in the presence of mild infections caused by the *Pneumococcus*, *M. tetragenus*, and certain Gram-negative diphtheroids; but every hæmothorax that contains streptococci, staphylococci, influenzal or anaerobic bacilli, should be treated as soon as possible by resection of a rib. When the effusion is very large, it is best to evacuate it by a preliminary aspiration. An ordinary wide resection close to the diaphragm yields fairly good results. So far as we have been able to trace the patients in England, all have recovered in three or four months, and more extensive operations for chronic empyema have not been required.

Two points to be considered in the surgery of infected hæmothorax are—how to deal with septic clot, and how to prevent secondary infections from invading the cavity. The difficulty of retained clot makes drainage through a slit in the intercostal spaces unsatisfactory, though this method has the advantage of aiding expansion of the lungs and checking secondary infections. The best recovery that we have seen was, as a matter of fact, in a case of mixed infection by streptococcus and gas bacillus which was treated by slit drainage. But in two others, death was directly caused by the faults of the method; so that it appears to us unwise to use it. When the infection is gross and mixed, and the contained fluid is abundantly purulent, it is best simply to insert a large tube and await the results of drainage. Rough handling of the inner pleural surfaces may break down inflammatory barriers and light up a fatal septicæmia. After a few days the cavity can be flushed out with hydrogen peroxide and some weak antiseptic, which will dislodge the septic clots. The introduction of Wright's hypertonic saline tablets caused smarting, and they did not produce any appreciable improvement in the cases in which they were tried by us.

A simple infection by staphylococci or by anaerobic bacilli may be treated by a method similar to that which Cantlie used for drainage of a liver abscess, and which other surgeons have employed for empyemata. The cavity is wiped free of clot by gauze mops. A long tube is sewn in by air-tight closure in successive layers of the pleura, muscles, and skin; and the end of this tube drains just under the surface of a bottle of weak carbolic placed on the floor.

The development of a purulent bronchitis is a dangerous complication of these infections, and its onset requires the free use of expectorant medicines.

Air in the chest, either as a complete pneumothorax or as a large pneumohæmothorax, sometimes raises a problem of great clinical difficulty. Fortunately only 3 out of the 12 cases that we have seen were infected. If infection is present, and it is allowed to remain untreated for long, the thickening of the pleura over the completely collapsed lung will check expansion later, and a huge empyema cavity will be the lasting result. To prevent this, the air and fluid should be removed by aspiration as early as possible, and an attempt made to establish adhesions between the lung and the chest wall. Resection should

not be performed until a later date. The air leak from the lung is generally found to be closed by the tenth day, and aspiration can then be successfully used. A manometer is needed with the aspirating apparatus in these cases, since the development of a negative pressure under suction gives the required proof that the air is no longer leaking from the lung.

Prognosis.—Infections by anaerobic bacilli often make an excellent recovery. The grave symptoms shown are not so much toxic as of a mechanical nature, owing to the rapid development of gas; and the patient rarely, if ever, exhibits the thready pulse, waxy yellow face,* low temperature, and repeated vomiting which are seen in poisoning when a limb is the seat of severe gas gangrene, and which almost invariably presage death. Staphylococcal infections also do well. Worst of all are the acute streptococcal cases, which may rapidly produce a hopeless septicæmia. In group *B*, 28 recoveries were seen in men infected by gas bacilli, and 7 deaths; while 8 pure streptococcal cases lived, and 3 died.

SUMMARY.

1. The total mortality of chest wounds which reach the base hospitals is 10 per cent.

2. Simple hæmorrhage never causes death after the third day. Sepsis is the main cause of the mortality from this time onward.

3. Primary infection of a hæmothorax occurs in 25 per cent of the effusions, and it is fatal in about one third of the infected cases.

4. The effused blood in a hæmothorax clots rapidly in all cases, but the type of clot varies.

5. A sterile hæmothorax should be emptied by aspiration, except when it is of small size.

6. Infection should be suspected in all cases which are not progressing favourably after the fourth day. It cannot be diagnosed with certainty on clinical features alone; a sample of the fluid must be withdrawn and examined bacteriologically.

7. A hæmothorax fluid which looks red and innocent may none the less be heavily infected.

8. The chest should be opened in all cases of infected hæmothorax, and as soon as possible.

9. The signs of air as well as blood in the chest may be caused by foul gas evolved in the course of an infection by anaerobic bacilli. Immediate resection is then required.

10. A complete pneumothorax, or a large pneumohæmothorax due to air leak from the lung, is not often infected. If infection is present, an attempt should be made to expand the lung again by aspiration before rib resection is performed.

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* See Fig. 39, p. 117, in the issue of this Journal for July, 1915.

ILLUSTRATIONS OF WAR SURGERY.

(*Continued from page* 120.)

[Under this heading we propose to publish during the War a series of drawings illustrative of military surgery in its various aspects. The BRITISH JOURNAL OF SURGERY is indebted to Col. Sir George H. Makins for his help in the selection of cases and for his clinical remarks on certain of those selected. The notes, supplied by various officers of the Royal Army Medical Corps under great pressure of work, are necessarily brief. The drawings have been made by Mr. A. K. Maxwell.]

A Case of Traumatic Herpes Zoster. (From No. 13 General Hospital, Boulogne. Under the care of CAPT. T. R. ELLIOTT, F.R.S.)

THE patient was wounded on April 23, by a shrapnel ball, which entered the chest at the left apex, behind and close to the superior vertebral angle of

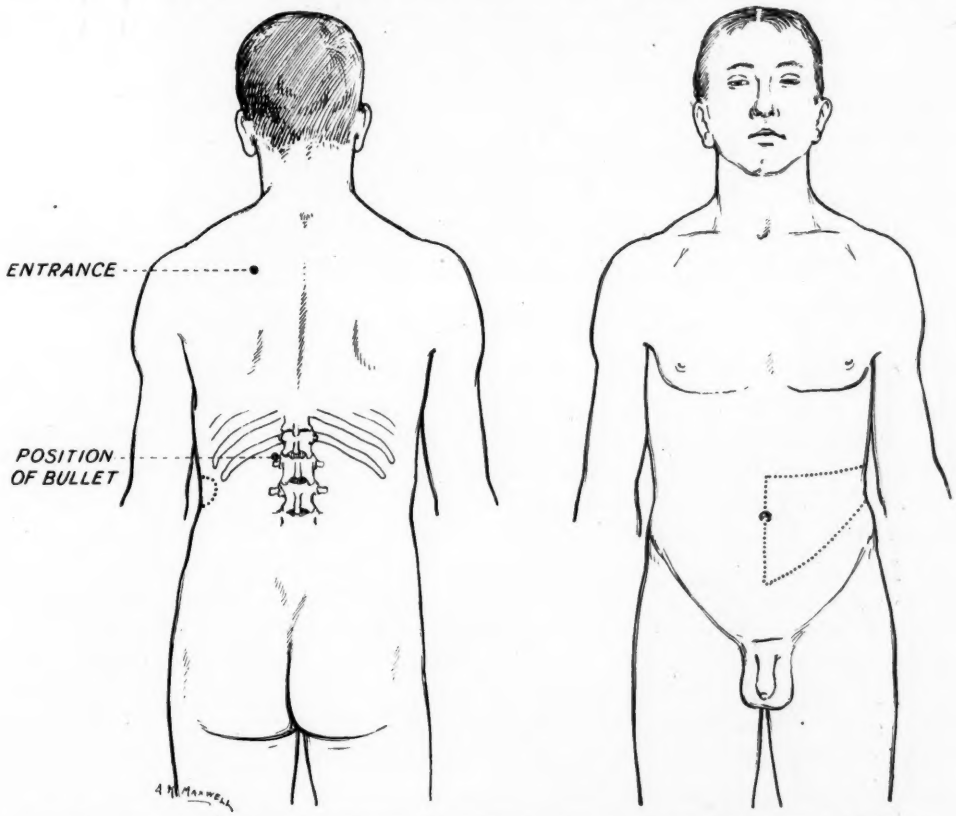


FIG. 80.—TRAUMATIC HERPES ZOSTER. Diagrams showing area affected and course of bullet.

the scapula. The ball traversed the thorax from above downwards, and was localized by the *x* rays as lying just below the left twelfth rib, an inch to the outer side of and anterior to the first lumbar vertebra.

On examination on April 27, at the 13th General Hospital, Boulogne, a sterile hæmothorax was found, reaching up to the middle of the scapula. The skin over the area mapped out in the black and white diagram (*Fig.* 80) showed the changes depicted in the drawing (*Fig.* 81). A pink flush marked out the affected area, and from this arose numerous red spots surmounted by tiny, clear vesicles, while a few of these were yellowish and purulent. The yellow tint has been exaggerated in the photographic reproduction of the sketch, and in consequence all the clear vesicles appear to be pustular. The change was limited strictly by the mid line of the abdomen, and it extended only a little way round into the loin. No pain was complained of.

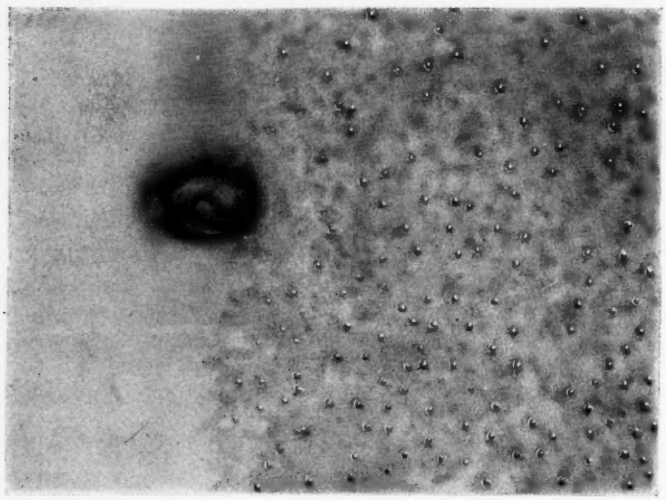


FIG. 81.—TRAUMATIC HERPES ZOSTER. The skin changes shown.

On May 5 the erythema and the vesicles had largely disappeared, but the area could be easily recognized by the roughness felt when the hand was passed over it. The patient was aware of slight hyperalgesia in the skin above the herpetic zone, but in the area itself there was no obvious change of sensation. A week later all had vanished, except a contracting field of roughness between the umbilicus and the pubes. [*Ref. No.* 32.]

Remarks by Capt. T. R. Elliott.—In this case the track of the bullet, if there was no deviation, lay outside the position of the posterior root ganglion. The injury was slight, probably indirect, and the herpes was unusually transient. But it conformed in its sudaminal type to that seen in three other cases of chest wound, the uniform erythema, the tiny vesicles over the whole area, and the roughness of the skin distinguishing it from the form usually seen in civil practice, where the vesicles are large and form big pustules which may give rise to permanent scars.

The herpes is beyond doubt caused by injury to the ganglia. In a series of over four hundred cases of chest wound, which included a large number with broken ribs and injuries to the intercostal nerves, only four were noted as presenting traumatic herpes; and in the other three of these the track of the missile ran close to the ganglia. The herpes was not seen bilaterally.

No case came under observation earlier than the fourth day, so that the minimum time required for the development of the herpes was not determined.

One of the cases died, and the history is worth quoting. The man was wounded by a bullet which traversed the right chest from above downwards, perforating the 2nd rib in front, breaking the 8th, 9th, and 10th at their angles, and injuring the bodies of the 9th and 10th thoracic vertebræ, while it escaped through the skin over the 10th dorsal spine. Sudaminal herpes was present over the distribution of the 9th intercostal nerve. The exit wound was septic, and on the eighth day a pleural effusion infected with streptococci was removed by aspiration. On the sixteenth day a rib was resected, but the patient became rapidly worse, showing signs of meningitis. He died on the twenty-third day, a few hours after a sudden 'cerebral seizure.'

Post mortem it was found that the bullet had torn the ganglion and root of the 9th nerve out of its sheath. Streptococci from the septic sinus had infected the pleural cavity and also entered the open tunnel of the dura mater nerve sheath, so causing an ascending meningitis. The veins of Galen were thrombosed, and this change was probably the cause of the final 'seizure.'

Remarks by Lieut.-Col. Gordon Holmes.—An eruption very similar to that described by Capt. Elliott is occasionally found associated with gunshot injuries of the spine; it occurred in six of the three hundred or so cases of which notes have been collected. In three it was practically identical with the appearance represented in the drawing, but the amount of hyperæmia of the skin of the affected zone varied; in one it was even more marked, while in another there was scarcely any redness. In the three other cases the eruption was predominantly papular with very few vesicles, at least in that stage in which it was observed.

As the herpes disappeared it generally left a reddish-brown discoloration of the skin, and some desquamation.

In one case the eruption appeared on the fifth day after the injury, in another on the twelfth day, and in a third on the fifteenth day; the exact dates on which it developed in the other three cases could not be definitely ascertained. In one patient the vesicular eruption persisted for seven days, but recurred a fortnight later in the same area; the zone it occupied was extremely hyperæsthetic from at least the second day after the injury. In this case the left seventh thoracic root ganglion was found at the post-mortem examination bruised and compressed by a fragment of bone which was driven on to it, and a similar lesion of the ganglion was found in the only other case in which an autopsy was obtained.

The state of sensation in the affected zone varies; there has generally been pain and marked hyperæsthesia to contact, and especially to rubbing, while the appreciation of pin-prick has been generally diminished, and in one case was completely lost.

Two Cases of Fungus Cerebri. (From No. 13 General Hospital, Boulogne. Under the care of Capt. Sidney Smith.)

Case 1.—The patient was wounded on April 1, by a bullet; he became unconscious at once, and later found both lower limbs and his right arm weak,

but his speech was unaffected. He was operated upon, probably next day, in a casualty clearing station, but exact details as to what was done at the operation were wanting.

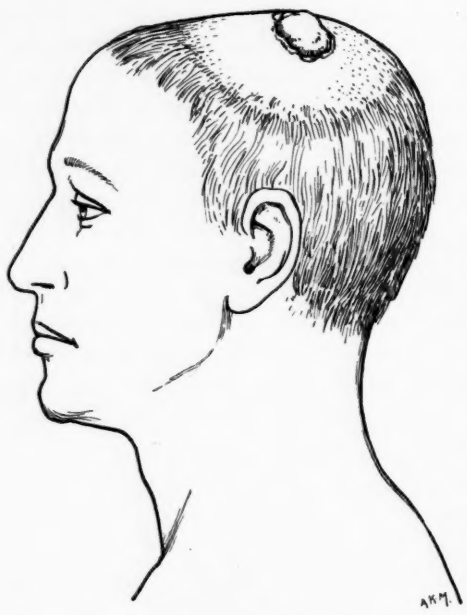


FIG. 82.—FUNGUS CEREBRI. Shown in detail in *Fig.* 83.

He was admitted to a base hospital three days later, and then had a defect in the left side of his skull which measured 4 × 5 cm. (*Fig.* 83), and reached the middle line 18 cm. behind the nasion; the edges of the scalp wound had obviously been excised, and some bone had been removed through the original wound. Disintegrated brain protruded through the opening.

The patient was then bright and intelligent; his temperature was only slightly raised, and his pulse-rate was 112. There was some weakness of the left side of his face; his right arm was rigid at the shoulder and completely paralyzed. Both legs were extended, adducted, and rotated inwards, and extremely rigid; no voluntary movement of either was possible, but troublesome reflex spasms occurred. All his deep reflexes were much exaggerated, and he had ankle clonus and an extensor response on each side. There was also much loss of all forms of sensation in his right arm and leg, less in his left leg.

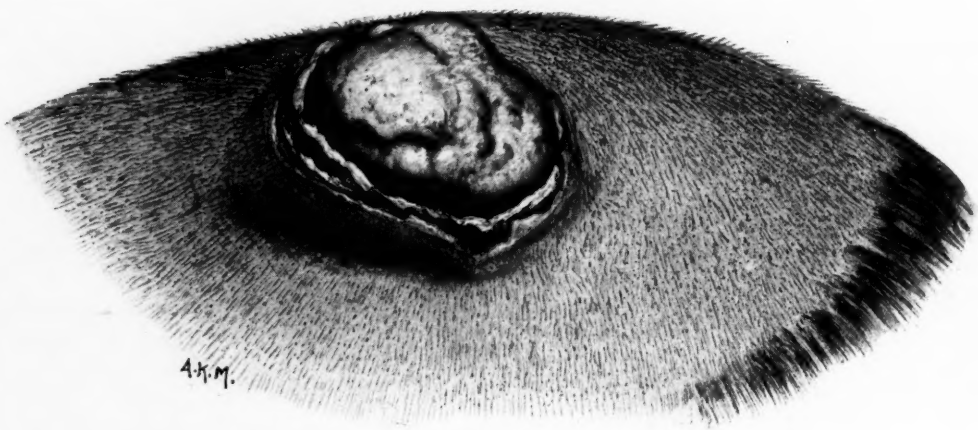


FIG. 83.—FUNGUS CEREBRI. The result of a bullet wound.

The patient remained four weeks in the base hospital; at first the cerebral hernia increased considerably in size, and involved the destruction of more brain, but it eventually subsided almost to the level of the skull. No

improvement in his symptoms occurred while he was under observation, except slight return of power in his left leg.

The paralysis of his right limbs was obviously due to the direct injury to the brain and the progressive softening and destruction of neighbouring parts on the development of the septic hernia, while the weakness of his left leg probably resulted from a local thrombosis of the longitudinal sinus or of the superior cerebral veins where they open into it. [*Ref. No.* 7.]

Case 2.—The patient was wounded on April 4, and was operated upon in a casualty clearing station next day. The wound was explored by a large flap, the skull trephined, and the inner table found depressed, with the brain lacerated beneath it. The edges of the original wound were excised, and the

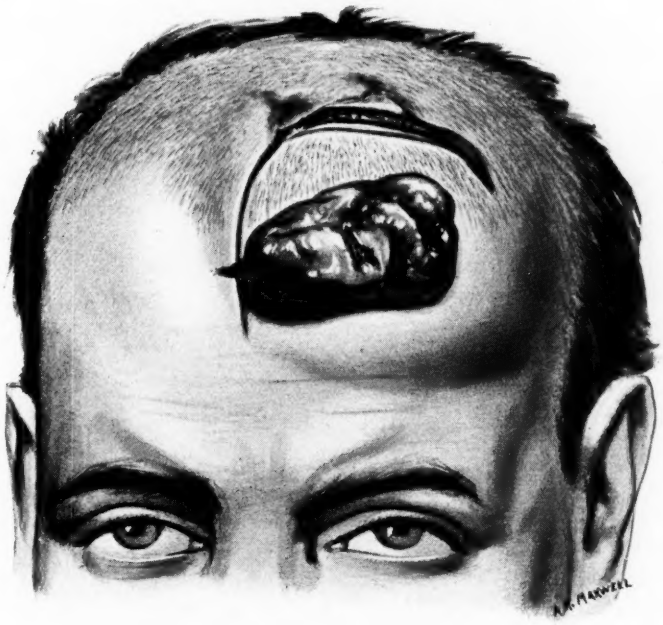


FIG. 84.—FUNGUS CEREBRI. Showing the strangulated brain and the flap wound.

flap was sutured loosely in position. Before the operation he was unconscious and noisy.

On admission to the base hospital next day he was unconscious; both the original wound and the scalp incision were very septic, and on opening the flap some pus escaped from under it. Only a small area of bone had been removed, and softened septic brain protruded through it. Examination showed many *B. perfringentes* in the pus. His temperature was 102°, and after a fortnight rose to 103·6°, and his general condition was very serious. The protrusion of brain increased and became strangulated, so as to form the fungus cerebri illustrated in the drawing (*Fig.* 84).

After about four weeks he began to improve, and his temperature had subsided to 99° when he was sent to England five weeks after the infliction

of the wound. The fungus cerebri diminished in size, but had not then quite subsided. [*Ref. No.* 12.]

Remarks on Fungus Cerebri by Lieut.-Col. Percy Sargent.

The formation of a 'hernia' or fungus cerebri is illustrated by *Figs.* 82, 83, and 84. The term 'hernia' is often used to describe this condition, but it is best kept to indicate the protrusion of uninjured brain through a large opening deliberately produced as a decompressive measure. The term 'fungus' is conveniently retained to designate such protrusions of damaged semi-strangulated septic brain and granulation tissue as are here illustrated.

The escape of brain matter from the cranial cavity which is so frequently seen in the earliest stages, is due to the sudden increase of pressure caused by the blow, and to the traumatic cerebral œdema which immediately follows. If no additional factor were to come into play to sustain and increase this pathological intracranial tension, any initial protrusion would disappear with the subsidence of the traumatic œdema, and no fungus cerebri would form. Infection of the wound, however, results in the onset of a secondary inflammatory œdema, which keeps up and increases the general intracranial pressure. This leads to a further protrusion of the softened brain through the dural opening, which becomes more and more tightly plugged, and consequently the drainage of the damaged and septic brain is increasingly interfered with. This interference causes a still further rise in the intracranial tension, so that a vicious circle is established. Unless relief is obtained either by natural subsidence of the inflammatory process, or by the establishment of free drainage, death ultimately ensues from meningitis.

A vertical meningitis spreading from the wound is not common unless the wound has been inadvisedly interfered with at a very early date, for the subarachnoid space rapidly becomes sealed off by adhesions which form between the dura and the pia-arachnoid, and this process is assisted by the fact that the swollen brain is pressed firmly against the dural opening. Within the first twenty-four to forty-eight hours, therefore, any manipulation of the damaged brain for the purpose of removing bone fragments, or any rapid lowering of the intracranial tension by lumbar puncture, is apt to be followed by a vertical meningitis spreading from the wound.

On the other hand, if, after this danger period is passed, free drainage of the damaged brain is not provided, the infective process extends deeply, the ventricles become involved, and a basal meningitis results.

Fungus cerebri therefore is an indication of the increased intracranial pressure which results from inflammatory œdema. When this elevation of pressure is progressive, the fungus increases in size, is tense, and pulsates but feebly; at the same time headache and optic neuritis are present, and these, together with other pressure symptoms, increase until death ensues. On the other hand, when the intracranial tension is relieved, the fungus becomes flaccid, pulsates freely, and shrinks in size more or less rapidly.

With an increasing fungus, the treatment must be directed firstly towards controlling the general intracranial pressure, and secondly to draining the infected necrotic brain connected with the fungus; and the second object can be greatly assisted by accomplishing the first.

Local Treatment.—Indriven fragments of bone should be removed, the utmost gentleness being used in order, firstly, to avoid tearing adhesions and so opening up the subarachnoid space; and secondly, to avoid spreading infection more deeply into the brain substance and so towards the ventricle. If bone spicules have already been removed, it is well to explore the track

Fig. 85.—Multiple Shell Wounds.

again, as occasionally (but rarely) a small collection of pus may be discovered and drained.

Reduction of Intracranial Pressure.—This would naturally be best achieved by removing bone and opening the dura freely around the fungus; but such a course is forbidden on account of the practical certainty of infecting

the subdural space. The other means available are (1) *Lumbar puncture*, and (2) *Contralateral decompression.*

1. *Lumbar Puncture.*—This is the more easily applicable method, with the additional advantage that examination of the fluid removed gives information as to the presence or absence of generalized meningitis.

In these cases the cerebrospinal pressure is generally found to be considerably raised, and a large quantity of fluid can easily be removed. It is well, however, not to allow more than from 4 to 6 drachms to escape at one sitting, lest the rapid disturbance of pressure within the skull should of itself lead to spread of infection. The operation may, however, be repeated daily or

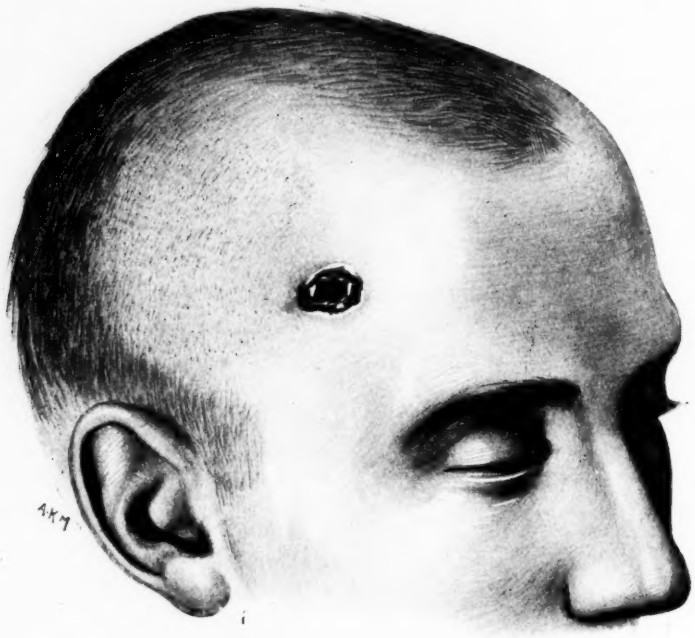


FIG. 86.—SHRAPNEL BULLET WOUND.

every other day, and the intracranial pressure be kept under control by that means.

2. *Contralateral Decompression.*—When repeated lumbar puncture fails to control the fungus, a subtemporal decompression may be done, in the hope that the complete relief so afforded may allow the necessary drainage of the septic brain at the site of injury to take place.

Multiple Shell Wounds of the Head. (From No. 13 General Hospital, Boulogne. Under the care of CAPT. SIDNEY SMITH.)

The patient was wounded on May 5, by shrapnel. He was unconscious till he reached the casualty clearing station, where he was operated upon. There were several septic wounds, chiefly in the right parietal region. Some

of them had been sutured, but the sutures had given way, leaving the gaping scalp wounds shown in the illustration (*Fig.* 85), with the skull exposed at their bottom.

In the wound above the right supra-orbital margin the skull had been opened, and septic disintegrated brain protruded through it.

There was some weakness of the left side of his face and of his left leg at

FIG. 87.—SHELL WOUND SIMULATING AN OPERATION FLAP.

the hip and knee, and the deep reflexes were exaggerated on this side. The scalp wounds cleaned up on frequent dressings and fomentations, but the fungus cerebri was still present when he was sent to England. [*Ref. No.* 21.]

The Entrance Wound of a Shrapnel Bullet. (From No. 13 General Hospital, Boulogne. Under the care of LIEUT. G. R. COLQUHOUN.)

The patient had been wounded two days previously by shrapnel. When admitted he was very dull and apathetic; when asked a question he

would usually give some related answer—e.g., asked what his regiment was, he would give his regimental number.

The cranial nerves, motor system, sensory system, and reflexes were all normal. *X*-ray examination showed a whole shrapnel bullet lying in the temporal lobe on the side opposite to the entrance wound. The latter (*Fig.* 86), from which protruded bone fragments and disintegrated brain matter, was cleansed and the track drained. Death occurred eight days later from meningitis. [*Ref. No.* 23.]

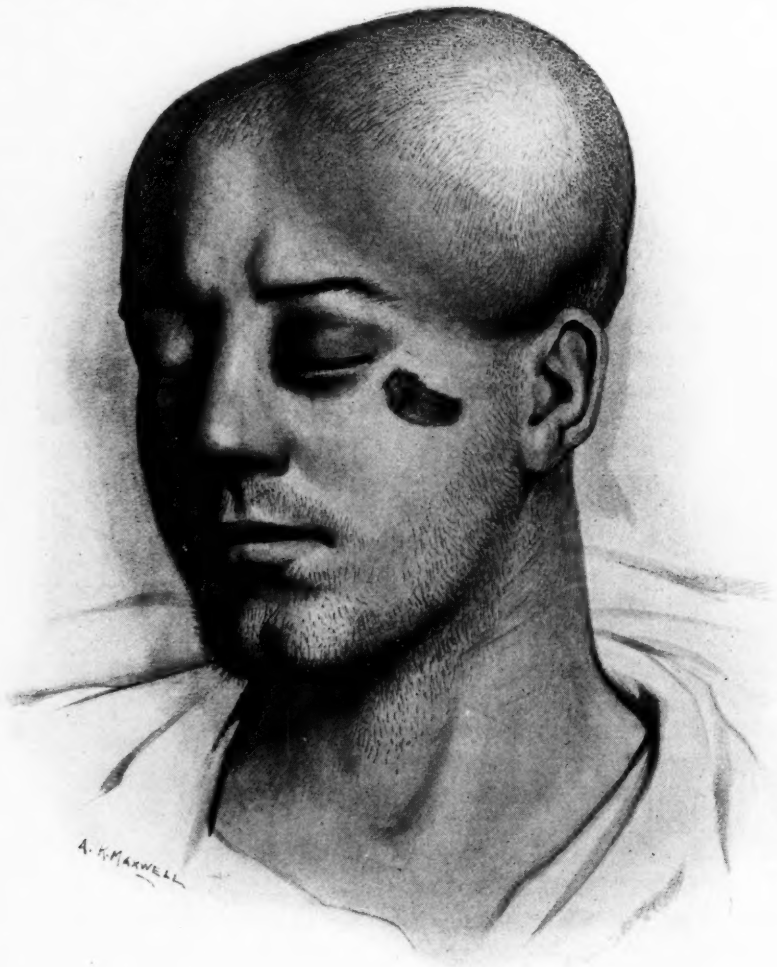


FIG. 88.—SHRAPNEL WOUND OF THE HEAD.

A curious Wound of the Head produced by a Fragment of Shell or Shrapnel Case, simulating a small Operation Flap. (From No. 13 General Hospital, Boulogne. Under the care of LIEUT. G. R. COLQUHOUN.)

The highest point of the flap was about one and a half inches above the eyebrow, the two ends of the wound were approximately at the level of the

internal and external canthus respectively (*Fig.* 87). On raising the flap the superior orbital margin was found to be powdered, and fragments had been driven into the protruding right frontal lobe. The globe of the eye was ruptured posteriorly.

On admission the patient was drowsy and irritable, but he answered rationally when shouted at, otherwise he was silent. There were no pareses:

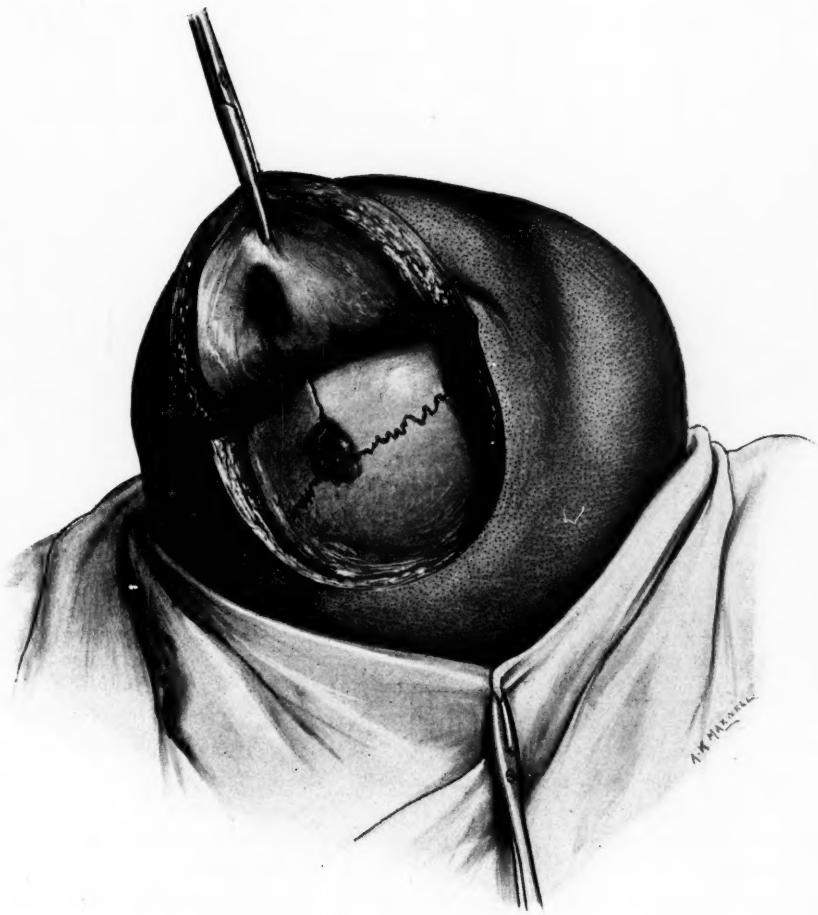


FIG. 89.—ENTRANCE WOUND OF THE SHRAPNEL BULLET.

all reflexes were present and normal, and there was no incontinence of urine or fæces.

The patient was anæsthetized, the wound was cleaned up and irrigated with 1 in 200 carbolic solution; the fragments of bone were removed from the substance of the frontal lobe, and the wound was left open. The general and local condition improved, the pulse and temperature never rising above 90° and 101° respectively, but the dull mental condition persisted. The man was sent to England on the fifteenth day. [*Ref. No.* 18.]

Shrapnel Wound of the Head. 'Elevated' Fracture of the Skull produced from within. (From No. 7 Stationary Hospital, Boulogne. Under the care of Dr. Graham Jones.)

A shrapnel bullet had entered immediately to the left of the mid line and three and a half inches above the inion. It could be felt beneath the enormously œdematous scalp (*Fig.* 88), at a point two inches vertically above the attachment of the left pinna. The patient was dull, did not understand speech fully, used no words except 'yes' and 'no,' and could not read.

The right face and tongue were weak, and complete right hemianopia was present. There was much loss of sense of position in the right upper limb, but little if any loss of power. The right lower limb was as strong as the left.

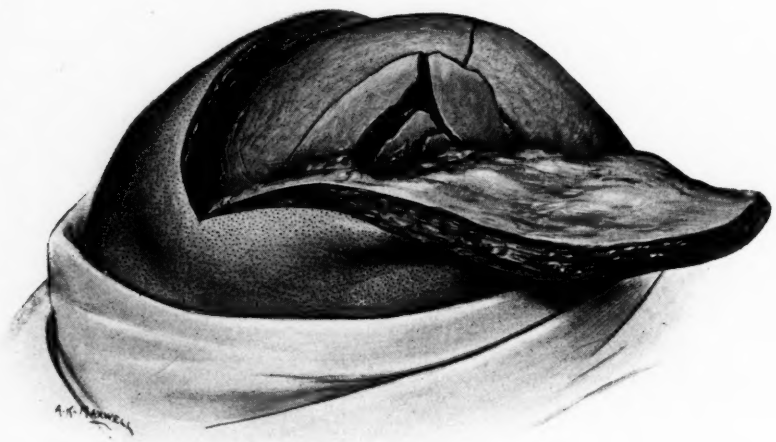


Fig. 90.—The Aperture of Exit.

Reflexes.—Arm jerks—R absent, L present; knee jerks and ankle jerks present and equal; left abdominal reflex greater than right; right plantar reflex extensor, left flexor.

The whole area was exposed by turning down a large flap, the commencement of which is shown in *Fig.* 89. The illustration shows the highly œdematous condition of the scalp, and also a fissure passing from the rounded opening towards the aperture of exit. It was then found that the bullet had passed beneath the bone and dura mater, and had produced at its exit further forward a large out-blown comminuted fracture. *Fig.* 90 shows this aperture of exit. The lifting of the fragments is well shown, and it will be observed that no opening of sufficient size to allow the passage of the ball appears to be present. Death occurred two days later. [*Ref. No.* 27.]

Bullet Wounds of left Thigh and Leg. (From No. 13 General Hospital, Boulogne. Under the care of Lieut. G. R. Colquhoun.)

A typical small rounded entrance aperture is seen just below the centre of the antero-internal margin of the thigh (*Fig.* 91). The 'explosive' exit

aperture in the upper third of the anterior and outer aspect of the leg is shown drawn to half-scale in *Fig.* 92.

The upper third of the tibia was finely comminuted. No actual loss of skin had been suffered, but the margins of the wound were prominent and widely separated by the extrusion of the lacerated muscles and displaced fragments of bone. The fibula was intact. Both main vessels pulsated nor-

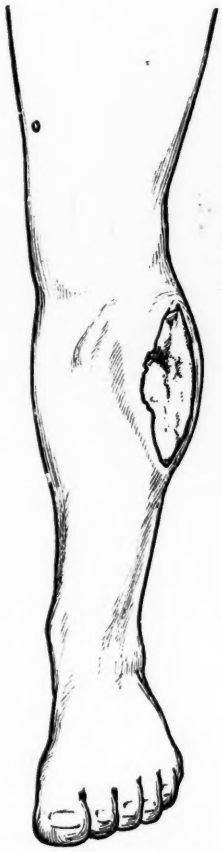


FIG. 91.—BULLET WOUND OF THIGH AND LEG.

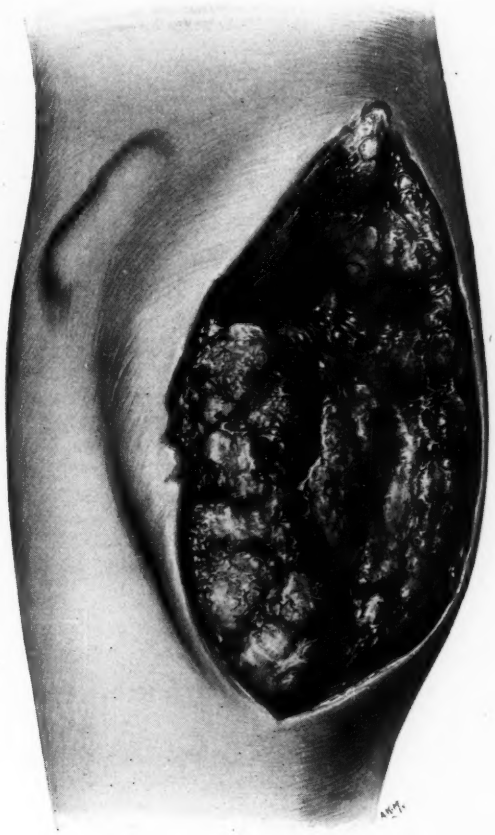


FIG. 92.—WOUND OF EXIT IN LEG.
Explosive' aperture caused by the regulation German bullet.

mally at the ankle. Gaseous cellulitis had developed before the patient reached the hospital and was evidenced by surrounding discoloration of the skin and crepitation on palpation. The limb was amputated by the flap method soon after the patient's admission. The amputation was closed by stitches, but freely drained by tubes at the angles. Primary union was obtained. [*Ref. No.* 15.]

An Extensive Shell Wound of the Back of the Right Thigh. (From No. 13 General Hospital, Boulogne. Under the care of CAPT. MUMFORD.)

The skin, fascia, and the hamstring muscles were widely divided (*Fig.* 93). At the time of admission, on the third day after the reception of the injury, the lacerated muscle was black and gangrenous on the surface, while from the

FIG. 93.—SHELL WOUND OF THIGH.

depths of the wound stinking bubbles of gas escaped freely. The great sciatic nerve was exposed in about four inches of its length, but uninjured.

Under treatment the sloughs separated, and the patient was sent home to England at the end of the second week, with practically no signs to be attributed to the exposed sciatic nerve. [*Ref. No.* 19.]

Extensive Laceration of the Anterior Abdominal Wall caused by a Fragment of a High-explosive Shell. (From No. 11 General Hospital, Boulogne. Under the care of CAPT. WOLFENDEN.)

The drawing was made upon the eighth day after the infliction of the injury (*Fig.* 94). At the time of admission the surface was severely infected. The skin had suffered considerably, a large portion having been torn away.

The floor of the inner half of the wound was formed by the aponeurosis of the external oblique muscle, while the outer half was occupied by severely lacerated portions of the oblique muscles, and the anterior superior spine of the ilium was exposed. There was considerable sloughing of the torn muscles.

FIG. 94.—SHELL WOUND OF ABDOMINAL WALL.

The patient was sent to England on the nineteenth day, the floor of the wound then having assumed a healthy granulating condition, discharging yellow pus, while epithelium was rapidly advancing from the margins. [*Ref. No.* 20.]

THE TREATMENT OF SEPTIC WOUNDS IN WAR BY MAGNESIUM SULPHATE SOLUTION.

By A. E. MORISON, Sunderland,
and W. J. TULLOCH, Newcastle-on-Tyne.

The present war has materially altered many of our previous ideas as to the treatment of wounds. Aseptic surgery has failed in their management; and though the simple and fashionable treatment by painting with tincture of iodine is satisfactory in a large number of wounds caused by rifle bullets, as a routine treatment for other wounds it is inefficient.

A very large proportion of war wounds now inflicted is caused by explosive shells, and in these it is rare to find that suppuration does not follow. As to the most efficient method of dealing with these wounds there is some difference of opinion; but we are becoming more impressed with the truth of Lister's teaching that the antiseptic treatment of wounds is of more prophylactic than therapeutic value. Once infection has occurred, more especially if it be in a deep-seated wound, antiseptics have a limited sphere of usefulness. Good results may frequently be obtained in the early stages of such injuries by the vigorous use of powerful antiseptics, such as pure carbolic acid, followed by free and dependent drainage. The disadvantage is that strong antiseptics tend not only to destroy the infective organisms, but are also destructive in greater or less degree of healthy tissues with which they come in contact. In addition to this drawback, their germicidal action is greatly reduced in the presence of blood serum and other similar substances, and in some instances so much so as to render them inert. Their use, therefore, is limited to recent cases, in which infection has not spread into the surrounding tissues; and the application of powerful chemicals that will destroy infective organisms has proved to be efficacious in these circumstances. Unfortunately, a large proportion of war wounds have an extensive area of infection, not only due to the presence of septic foreign bodies, but from the nature of the injuries there is a large seriously devitalized area wherein organisms find a suitable nidus for their protection, growth, and development. Many of these cases are seriously infected before they come into the surgeon's hands for treatment; and the employment of antiseptics may then do more harm than good.

It is because of this limitation of the antiseptic treatment of wounds that other methods have been introduced. The one now claiming most attention, and from which the distinguished authors of it state that they obtain the best results, is the treatment by hypertonic solutions. These consist of substances sufficiently strong to have an osmotic effect on the tissues. Bier's passive hyperæmia was the first instalment of the principle of lymph lavage; but the amount of active lymph resulting from this is less than that produced by hypertonic solutions.

For some years in civil hospitals to which many accidents from shipyards and coal mines are sent, I have been employing with great advantage a saturated solution of magnesium sulphate. The effect of it on the progress of these cases so impressed me, that when opportunity occurred for the treatment of war wounds, I used magnesium sulphate solution in French and English hospitals. The results have exceeded my most sanguine expectations, and all of my septic cases are now treated on the lines indicated below. W. J. Tulloch, bacteriologist to the Northumberland War Hospital, has kindly undertaken experimental work on some of the patients in my wards, and his findings support my practice.

From the clinical side, in addition to points indicated by Dr. Tulloch, one most important requirement of any dressing applied to a septic, and consequently, painful wound, is that it should be easy of application; for the comfort of the patient must always be a prominent consideration in any form of treatment. Frequent changing of dressings, complicated apparatus, anything that causes more than ordinary inconvenience, is undesirable and may be harmful. The application of sulphate of magnesium is painless, is easily carried out, and the dressings, even in the most septic cases, need only to be changed twice a day.

Method of Preparation.—A saturated solution of the salt has given the best results, both clinically and experimentally. Magnesium sulphate 40 oz., dissolved in 10 oz. of glycerin and 30 oz. of boiling water, and sterilized in an autoclave, makes the solution ready for use.

Mode of Application.—In recent injuries, the wound is freely opened up, the bullet, portion of shell, clothing, or other foreign body is removed, and the whole wounded surface is swabbed over with pure carbolic acid. In the case of fractures, the ends of the bone are treated in the same way, and loose but attached fragments are not removed. The wound is gently packed for twenty-four hours with gauze wrung out of carbolic lotion (1 in 20), and antiseptic wool applied as an outer dressing. At the end of this time the wound is dressed: the gauze plug is removed, the wound is syringed out with magnesium sulphate solution, and *loosely* packed with sterile gauze wrung not too hard out of the same solution, and the whole area of the wound is then covered with a double layer of gauze or lint saturated with solution, over which a piece of jaconet, then cotton wool, is placed, the whole being fixed loosely by a bandage.

In the case of wounds of later date, where sepsis and suppuration are fully established, the treatment by carbolic acid is omitted, and magnesium sulphate solution is commenced at once.

Dressings, even in the worst cases, are only changed every twelve hours, thus saving the patient much discomfort and trouble. The effect on the wound is very striking. In two or three days pus has almost disappeared, sloughs begin to separate, and the whole surface of the wound presents a bright-red colour. The granulations never become flabby or œdematous, but instead a firm, vascular healing wound is seen. The growth of epithelium from the edges of the wound proceeds vigorously, and the treatment may be continued with advantage until the entire wound is healed.

We tried diluting the solution a half, a quarter, or an eighth in several

cases, and also substituting magnesium chloride in half the strength of the sulphate (1 in 4); but on every occasion on which this was done, pus again appeared in the wound, the granulations became flabby, weak, and œdematous, and then bled too freely when touched. On returning to the stronger solution the wound soon again resumed a healthy appearance.

Constitutional symptoms seldom occur, probably owing to the fact that absorption is prevented by the density of the granulations; there is therefore no general disturbance of health, there is an absence of lymphatic and glandular infection, and secondary abscesses are almost unknown. The effect in the majority of compound fractures is very quickly manifest. Pus rapidly disappears, and the amount of necrosis in comminuted cases appears, as would be expected when infection is diminished, to be materially less.

EXPERIMENTAL INVESTIGATION OF MAGNESIUM SULPHATE SOLUTION.

By W. J. TULLOCH.

The following note, which I wish to be considered as a foreword rather than as a communication, relates to experimental work that has been undertaken in the investigation of the properties of magnesium sulphate, as this salt has been successfully employed by Mr. A. E. Morison in the treatment of wounds. We do not claim any antiseptic properties for the solution that is made use of; and we wish it to be clearly understood that the method of treatment outlined above ought only to be employed after preliminary cleansing of the wounds by antiseptics has been carried out.

The principle of the method is the same as that of Wright's hypertonic saline therapy; but we believe that magnesium sulphate is a better salt to employ for producing osmosis than is sodium chloride.

The ideal salt for producing osmosis should have certain features in addition to its power of inducing 'lymph lavage': (1) It should not be readily absorbed; (2) It should not hinder the growth of granulation tissue—if possible, it should stimulate such growth; (3) The type of granulation that it gives rise to should be flat, compact, and vascular; (4) It should inhibit the digestive power of the leucocytes in the wound exudate but not in the granulation tissue; (5) It should restrain the growth of organisms in the exudate.

It will be seen that certain of these requirements are interdependent, the possession of one involving the possession of the others—though not of all the others. Magnesium sulphate to some extent fulfils these requirements. We know from a study of pharmacology and from certain experiments of physical chemistry that this salt is not readily absorbed. If it be not absorbed it is improbable that it will—directly, at least—interfere with the production of granulations. It is probable, too, that a salt which is not absorbed will give rise to more compact granulation tissue than will one which is absorbed. Absorption of a hypertonic solution from the exterior would probably be followed by an absorption by the granulations of fluid from the deeper-lying tissues. A condition of water stasis might ensue, so leading to œdema of the growing tissue. Of course, this condition might be only transient; but there is some clinical evidence that œdema may occur if a readily absorbable salt is

employed. Again, a salt which is not absorbed cannot interfere with the function of the living leucocytes in the granulations. This appears to me to be a point of considerable importance; for it is well known that the phagocytic power of the white cells is much reduced in presence of solutions of higher tonicity than their normal surroundings. These points can only be satisfactorily elucidated by extensive clinical investigation. The influence of the treatment upon the function of living leucocytes could be determined by opsonic tests, comparing serum from wounds treated by the method under consideration with serum from wounds treated otherwise. This work we propose to undertake in future.

The influence that the solution exerts upon the digestive activities of pus is difficult to determine. Besides technical difficulties to be overcome, one meets with the greater difficulty of interpreting results; for we are dealing with what are really unknown factors. We do not know the mechanism of digestion by leucocyte ferments, nor do we know whether these cells liberate one or several ferments. That proteolytic ferments are present in leucocytes I do not think is open to doubt. Experiments have been carried out which tend to show that magnesium sulphate is able to inhibit the action of the proteolytic ferment to a greater extent than does magnesium chloride, sodium chloride, or sodium sulphate; but as the method which we were forced to employ in this examination is open to certain objections, we hesitate to draw definite conclusions from the results obtained. Other methods of investigation are being devised, and the preliminary experiments appear to corroborate the previous findings.

Lastly, I may state that we have considerable experimental evidence that magnesium salts markedly interfere—apart from any influence that the tonicity of the solution employed may have—with the growth of certain organisms. The organism that appears to be most susceptible to this action—which is probably dependent on the magnesium ion—is the streptococcus; but *B. coli* and *B. pyocyaneus* undergo considerable modification in morphology, and some modification in cultural characters, in presence of solutions of magnesium salts.

CONCLUSIONS.

1. Magnesium sulphate, by virtue of its being absorbed with difficulty, has certain advantages over other salts used for cleansing wounds by osmosis.
2. It also appears to have the desirable property of interfering with the digestive activities of pus.
3. It inhibits to some extent the growth of certain bacteria commonly found infecting wounds.

We are indebted to Lieut.-Col. John Prescott, R.A.M.C., D.S.O., for permission to present the results of our investigations at the Northumberland War Hospital.

A NOTE ON THE TREATMENT OF TRAUMATIC ANEURYSMS RESULTING FROM BULLET WOUNDS.

By RUTHERFORD MORISON, Newcastle-upon-Tyne.

It is obvious to anyone who has seen many bullet wounds, that the tendency is for such missiles to push important structures like blood-vessels and nerves aside, and do no material damage. This could only occur if the vessels and nerves were mobile, but, so far as I can find, no importance has been attached to this point in current literature. Consequently, since it may be one of great practical importance, I am induced to record some experience bearing upon it.

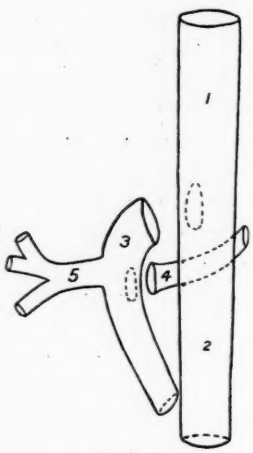


Fig. 95.
Femoral Region.

(1) Right common femoral artery. (2) Superficial femoral artery. (3) Deep femoral artery. (4) Internal circumflex artery. (5) External circumflex artery.

Case.—T. G., age 28, was admitted to the Royal Victoria Infirmary, Newcastle-upon-Tyne, on July 4, 1913.

History.—Six months before his admission the patient was accidentally shot with a revolver at close range, and the bullet went through his thigh. The wound did not bleed much, and it was dressed in the accident room of the hospital. The thigh swelled very much, but this gradually disappeared. He next noticed a localized lump, gradually increasing in size. The chief trouble caused by it was a throbbing and weakness, with sufficient pain in the leg to make the latter useless for work.

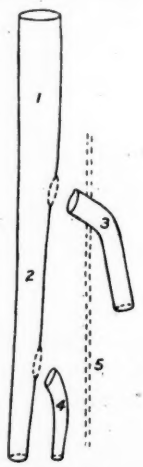


Fig. 96.
Popliteal Region.

(1) Popliteal artery from outer side. (2) Posterior tibial artery. (3) Anterior tibial artery. (4) Peroneal artery. (5) Interosseous membrane.

On Admission.—The small entry and exit wounds of the bullet were marked by scars in front and behind. The entry wound was over the centre of Scarpa's triangle, the exit at the lower border of the middle of the gluteal fold. There was a swelling the size of a cocoanut extending from the wound of entry in Scarpa's triangle to the line of the adductor magnus behind. It had the characters—pulsation, thrill, and harsh murmur, all arrested by pressure on the femoral artery above—of an arteriovenous aneurysm. Pulsation and thrill were entirely arrested by pressure on the artery above, and the aneurysm could then be emptied by gentle pressure. The thrill soon reappeared if pressure were relaxed on the artery above, but not if it were at the same time occluded below.

Operation, July 12, by Mr. Morison.—The femoral artery was exposed by a long incision over it. The intention was to clamp the common femoral artery above and the superficial femoral below, to empty the aneurysm, expose the holes in the artery and vein, and close each by a suture. On exposing the vessels it was evident that

this was impossible, as all of the tissues in the neighbourhood consisted of tough cicatricial tissue. After occluding the artery above and below with Crile's clamps, the sac of the aneurysm was opened; a terrifying rush of blood followed. With much difficulty two large arteries entering the sac from behind were caught, and the bleeding was arrested. There was a large hole almost encircling the femoral artery in the side of it next the vein. The artery was tied above and below this, and the wounded vein was treated in the same way. The sac was larger than it appeared at the examination to be, and extended into the adductor region, forming a cavity as large as the fœtal head. The inside of it was quite smooth and glistening, and looked as if it were lined by endothelium. A portion of this was removed for microscopic examination. The wound was entirely closed without drainage, and was completely healed when the dressing was removed on July 21.

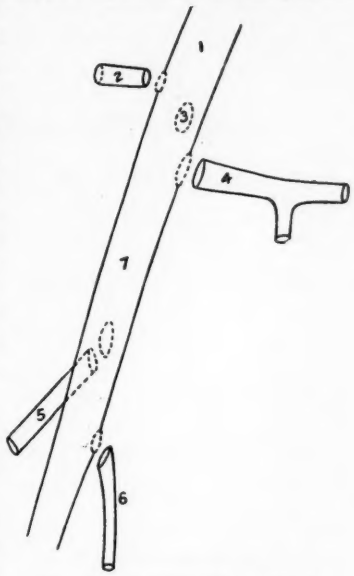


FIG. 97.—AXILLARY REGION.

(1) Axillary artery. (2) Anterior circumflex artery. (3) Posterior circumflex artery. (4) Subscapular artery. (5) Superior profunda artery. (6) Inferior profunda artery. (7) Brachial artery.

PATHOLOGIST'S REPORT ON SPECIMEN EXCISED.—"There is no trace of endothelial lining. The tissue shows no trace of remains of structure of vessel wall."

SUBSEQUENT PROGRESS.—There never was any sign of circulatory difficulty in the leg, and when the patient left the hospital there was a strong pulse in both of his tibial arteries.

Such an experience was one not to be forgotten, but it did not convey any special message to me until I was helping Colonel Richardson with an arterio-venous aneurysm in the same situation in a soldier this year. Occlusion of the vessel above and below, opening of the aneurysm, subsequent furious bleeding most difficult to stop—and then I saw the explanation.

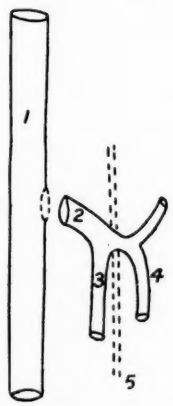


FIG. 98.
REGION OF ULNAR ARTERY.

(1) Ulnar artery. (2) Common interosseous artery. (3) Anterior interosseous artery. (4) Posterior interosseous artery. (5) Interosseous membrane.

It is this: The escape of an artery from a bullet is due to its elasticity and mobility. At points where branches arise the artery is tethered by them, so that it becomes fixed and is pierced by the impact of the bullet, and the branches are either torn through or caught and divided.

The lesson is clear. Control of the artery above and below will not suffice. It is necessary to command the entire circulation of the limb before the aneurysm is opened in these cases.

Figs. 95, 96, 97, and 98, drawn for me by Major D'Oyly Grange, illustrate special regions in the extremities which are likely to cause trouble in operations on such aneurysms, and explain the way in which the injuries are caused.

TRAUMATIC AND ARTERIO-VENOUS ANEURYSM.

A FIRST SERIES OF CASES OCCURRING DURING THE PRESENT WAR.

I.—FOUR CASES FROM THE 1st NORTHERN GENERAL HOSPITAL.

By Major G. GREY TURNER, R.A.M.C.(T.)

The cases here recorded comprise the whole of my experience of traumatic aneurysm the result of war. They have all occurred within the last twelve months, and small as is their number, they furnish a striking commentary on the ravages produced by modern weapons. In civil practice in the midst of one of the largest industrial districts in England, I have only had three cases of traumatic aneurysm under my care during the last fifteen years.

Case 1.—Arterio-venous Aneurysm of the External Carotid Artery.

The patient was shot through the neck at the battle of the Aisne seven weeks before his admission to this hospital. The bullet entered about the middle of the posterior border of the sternomastoid on the right side, and found an exit on the opposite side of the front of the neck at a point about an inch lower down. The wounds were small and clean, and healed without any trouble. A week after being discharged from a hospital as cured, he noticed a slight swelling on the right side of the neck just by the side of the larynx. The man observed that there was slight pulsation, and that the swelling steadily increased in size up to the time that he applied for admission, a fortnight after the swelling was first noticed.

The patient was found to be a tall, thin man, 29 years of age, who spoke with a slightly husky voice (unfortunately the larynx was not examined at this time). There was a small circular scar representing the wound of entrance, and a scarcely perceptible scar on the opposite side of the neck where the bullet found its exit. Just opposite the upper border of the larynx on the right side, and directly in the track of the bullet, there was an obvious pulsating swelling which felt about the size of a hen's egg. The pulsation was expansile, was attended by an ordinary systolic bruit, and could be completely arrested by pressure on the carotid on the proximal side. There was no abnormal enlargement of the superficial veins in the vicinity. Beyond the presence of the swelling and the slight hoarseness, the patient had no symptoms whatever, and during the few days he was under observation the aneurysm did not undergo any change.

Operation, Nov. 5, 1914.—General anæsthesia by chloroform and ether. An incision four inches long was made down the anterior border of the sterno-

mastoid, exposing the aneurysm. As soon as the superficial parts had been incised the tissues were found to be œdematous, as though there had been some antecedent exudation. There was no unusual vascularity. There was a definite sac projecting forwards, and this was being carefully exposed, when suddenly, following a touch of the knife, there was a tremendous gush of blood, which could only be arrested by thrusting the finger into the opening. Up to this point it had been hoped to carry out some type of conservative operation (Matas), but it now became a question of arresting the flow of blood, and this proved a matter of no small difficulty. The trunk of the external carotid was exposed and clamped, but with difficulty, owing to the matting of the parts in the sheath. This did not by any means stop the hæmorrhage, which, though considerably diminished, was still serious. The internal jugular vein was then caught and tied, but it was necessary to tie the upper ends of both artery and vein before the bleeding could be completely arrested. During this process the sac was cut away and the facial and lingual arteries which arose from the neighbourhood were ligated, so that the operation really amounted to an excision. It was found that the external carotid had been ligatured just above the bifurcation. Especial care was taken of the vagus nerve, and it was seen to be a little reddened and thickened where it lay behind the sac. All bleeding points having been tied, the incision was closed with interrupted sutures, a drain tube being left in. The operation was well borne, and the patient had no untoward symptoms, convalescence being very rapid. The hoarseness was a little more marked after the operation, but this symptom appeared to give him very little trouble. Before leaving the hospital the larynx was examined by Capt. F. W. Wilson, who reported complete paralysis of the right cord. The condition of the voice steadily improved, and by February there was distinct movement on phonation. By June the hoarseness had almost gone, while, as seen by the laryngoscope, the condition of the affected cord had greatly improved. [*Ref. No.* 47.]

Remarks.—Unfortunately, the pathological condition was not carefully made out in this case, the parts being much destroyed during the progress of the operation, which was rendered very difficult by the sudden hæmorrhage. In any case in which direct interference with a similar aneurysm is contemplated, it would be wise to avoid the aneurysm carefully until the vessels above and below have been exposed and dealt with either by temporary ligature or clamping. If conditions were found similar to those in *Case* 4 (*Figs.* 102 and 103), suture of the apertures could probably be accomplished, and in vessels of the size and importance of the carotids such conservative treatment would be worth attempting.

The accompanying nerve injury is interesting and important. Such a possibility must always be kept in mind, because the type of injury likely to lead to aneurysm is particularly prone to involve associated nerves. In a case in which a portion of shell casing had lodged in the brachial artery, the musculospiral nerve had been completely divided, and in an example of traumatic aneurysm at the bend of the elbow in a munition worker, the median nerve was partially divided, the separated ends being incorporated in the sac.

Case 2.—**Circumscribed Traumatic Aneurysm of the Posterior Tibial Artery.**

When making an attack on the afternoon of Dec. 21, 1914, with the object of recapturing some trenches, the patient was wounded in the left leg by a rifle bullet which went through the calf from front to back. He was shot in the middle of a ploughed field, and after lying a short time crawled back about two hundred yards into an old trench. This was muddy, and the patient was already soaked to the waist as the result of crawling through some ditches. At night he saw the stretcher-bearers, who said they would come back for him; but no one turned up, so he tried to keep awake until dawn, when he hoped they might come out to look for him. He thinks, however, that he must have fallen asleep; and when he awakened he wanted to move out, but found his legs so stiff that he was unable to do so. All day he lay in the trench, sleeping and dreaming, and at dark he thought he would try and keep awake. At 5.0 p.m. he was discovered by the R.A.M.C., and taken to a dressing station. All this time he had had nothing to eat and only a little water to drink. When taken out of the trench he was cold and numb, with pain in the groin and back, his legs felt dead, and when they got warm he began to have pain in them. After being in hospital in France he was transferred to England, and arrived in Newcastle in the early morning of Dec. 27.

The patient, age 30, was found to be thin and worn, bearing the impress of his severe ordeal. He complained of 'frostbite,' and said that he was unable to feel in the toes of his left foot. Locally there was a wound made by the bullet, which had entered between the tibia and fibula in front, just about the junction of the upper with the middle third of the leg, and had come out through the centre of the calf. There was a considerable blood effusion all up the back of the limb, and the whole of the calf was hard and very tender. Though he complained of the foot being cold, and though the toes looked blue and shrivelled, the anterior tibial artery could be felt pulsating freely. By Dec. 30 there was definite gangrene of the little toe and a small part of its neighbour. The patient still complained of great pain, but more up the back of the leg than in the foot. He was restless, had bad nights, and was not able to take food well, and generally complained like those suffering from frostbite or trench-feet. About Jan. 16 he had more pain than ever in the leg, and it was noticed for the first time that there was definite pulsation in the calf, suggesting a traumatic aneurysm. After this, the general swelling went down, but the pain increased, and the localized swelling in the calf became more obvious. It was recognized that an operation for the treatment of the aneurysm would be necessary; but by waiting a few days it was hoped that the gangrene of the foot would be completely demarcated, so that one interference would suffice. An elastic bandage over the aneurysm gave some relief; but opium was necessary for the severe pain. By Jan. 22 the gangrenous toes were almost completely separated (*Fig.* 99), and on Jan. 23 the following procedure was carried out under general anæsthesia :—

Operation.—A tourniquet was applied, and an incision about four inches long made directly over the aneurysm. When the superficial muscles were

divided, a cavity was opened about the size of a cricket ball, full of recent blood-clot and with fairly well-defined smooth walls. After removal of the clot it was observed that where the vessels might be expected to lie there was a good deal of shreddy material, but the vessels themselves could not be identified. At the bottom of the cavity there was a hole through the tibia of sufficient size to admit the forefinger easily. What were thought to be the ends of the posterior tibial artery were caught and tied. The cavity was then packed with gauze and the tourniquet removed. After withdrawing the gauze the hæmorrhage was very free, and the swish from some large vessel could be heard; but in spite of all our efforts the actual bleeding point could not be found, and the hæmorrhage could not be controlled by forcipressure. As there was far too much bleeding to be safely controlled by gauze packing, the tourniquet was reapplied, the patient turned on to his back, and the femoral artery in Hunter's canal tied and divided between ligatures. I then

FIG. 99.—TRAUMATIC ANEURYSM OF THE POSTERIOR TIBIAL ARTERY.
The figure shows the swelling in the calf and the gangrene of the toes.

removed the packing, in the confident expectation that the hæmorrhage would have ceased; but to my great astonishment, though diminished by half, it was still alarming, and especially so in view of the condition which the patient had reached at this stage of the operation. The blood welled up from the very depths of the cavity, and whenever the gauze was removed the sound of a spouting artery could be distinctly heard, though no vessel could be seen. It occurred to me that the bleeding might come from an especially large nutrient artery to the tibia, or from the anterior tibial, the blood finding its way through the hole in the bone; but the patient was too ill to tempt me to cut down on the latter from the front. Gauze packing scarcely sufficed to stay the stream, and the plugs rapidly became saturated with blood; so I packed the hole in the tibia and the immediate vicinity with strips of lint

soaked in turpentine and squeezed almost dry, the more superficial parts of the cavity being filled with iodoform gauze. This was entirely successful, and there was no further anxiety from hæmorrhage. To complete the operation the little toe and part of its fellow were removed, and the patient was sent back to bed in rather a collapsed condition.

For the first twenty-four hours the effects of the loss of blood were very marked; but after this time the general condition gave no further cause for anxiety. The limb was always warm, and there was never any suspicion of an extension of the gangrene. The gauzes were removed without further hæmorrhage, and the cavity rapidly closed. By March 1, 1915, the man was very well, all the wounds being practically healed. He could move the foot and the toes; but there was some loss of sensation, and the knee was flexed to half a right angle. With the aid of extension and massage the flexion was gradually and almost completely overcome. There was some necrosis of the head of the fifth metatarsal; this had to be removed under anæsthesia, and the wound left was very slow in healing. By the end of May he was sufficiently recovered to leave the hospital, though the knee was still a little flexed, and the leg thin and with marked nutritional change. [*Ref. No.* 48.]

Remarks.—In this case nearly a month elapsed between the casualty and the development of the localized aneurysm. If there had been no question of frostbite, and I had examined the leg with more care in the earlier stages, it is quite likely that some physical signs of a diffuse traumatic aneurysm would have been found. It also shows the necessity of carefully scrutinizing cases of traversing wounds of the limbs from time to time, lest the earlier stages of aneurysm be overlooked. The difficulties of the operation were quite unexpected, and the freedom of the collateral circulation was a revelation considering the short duration of the interference with the normal state of affairs.

Case 3.—**Circumscribed Traumatic Aneurysm of the Popliteal Artery.**

On May 15, 1915, this man was peppered with shrapnel on the left thigh and leg, especially in the region of the knee. He was knocked down, and lay for an hour, when he was helped to a dressing station. There was very little pain or bleeding. For a week he was in hospital at Etaples, and was then sent over to the 1st Northern General Hospital, where he arrived on May 25. At this time the wounds were almost all healed, and were apparently the result of only trivial injuries. No *x*-ray examination was made. After a few days he was allowed to be up and about, and on June 12 was sent to a convalescent home. He did complain of a little pain behind the knee the day before leaving Newcastle, but there was no swelling and it did not seem to require attention. The man subsequently stated that from this time onwards there was always some pain behind the knee, and that at the convalescent home the circumference of the affected limb was found to be half an inch greater than the opposite side, while by the end of a week the difference had increased to an inch. The knee was always a little stiff, and he was not able to straighten it to quite the full extent. While at the home he was up every day and walked about with the other men, playing games as they did. On the night of Friday, June 25, he retired at 8.30 and went to sleep

as usual. At 12.0 p.m. he was suddenly awakened by severe pain all over the affected limb. The leg was slightly more flexed, and there was a large swelling behind the knee. There was no especial strain on the leg on this particular day, and certainly no injury. The pain and swelling increased, and on this account he was re-admitted to the 1st Northern General Hospital on July 3.

When seen, the left leg was partially flexed, and there was a large swelling at the back of the knee. The swelling extended from the lower part of the thigh to the upper part of the tibia, more than filling the popliteal space. It projected backwards like a large rubber ball, and so much laterally as to be seen on both aspects of the knee when viewed from the front. There was a slight expansile pulsation, but no thrill. On compressing the femoral artery the pulsation ceased and the tumour slightly diminished in size. Pulsation in the anterior and posterior tibial arteries could not be felt. A loud blowing systolic murmur could be heard all over the swelling. There was no venous engorgement or œdema, and no evidence of nerve lesion. The patient was in good general condition, but suffered a considerable amount of pain. In order to diminish the circulation through the aneurysm before interfering locally, it was decided to tie the superficial femoral.

Operation, July 5, 1915.—The femoral artery was tied in Hunter's canal and divided between ligatures. The aneurysm at once became a little smaller. On the following day the patient was very well and without pain; the foot was cold, but the circulation was evidently not arrested; the aneurysm was as large as before, but softer and without pulsation or bruit. On July 11 the patient remained well and without pain; the aneurysm was no smaller, but was softer and without pulsation; but a systolic blowing murmur could be heard, and was thought to be louder than before the operation. On July 13 the wound was dressed, and found to be perfectly healed. There was no further change in the aneurysm. On July 23 the patient complained of some pain in the aneurysm which had kept him awake, and there was a slight rise of temperature. There was no obvious local change, and nothing to suggest thrombosis or infection. It was decided to explore the swelling next day.

Operation, July 24, 1915.—With a tourniquet on the thigh, a straight incision about six and a half inches long was made over the back of the aneurysm. As soon as the popliteal fascia was divided a large cavity was opened, extending upwards to the junction of the middle and lower thirds of the femur, and downwards to the junction of the upper with the middle third of the tibia. The cavity contained two or three handfuls of dark blood-clot, some old liquefied blood-clot with a strong smell, and a small amount of recent blood. Its walls were perfectly smooth, regular, and glistening, and were composed of the boundaries of the popliteal space considerably extended. The external popliteal nerve ran across the cavity, and was covered with some ragged blood-clots and stained by old blood; but the other structures were evidently outside the lining of the cavity. On the floor of the cavity the vessels were felt, and just about the centre of the popliteal artery was an oval aperture about three-eighths of an inch long by a quarter of an inch across. Its edges were beautifully smooth, and it looked

as though it had been caused by a process of gradual erosion. Above and below this opening the vessels were covered by the smooth lining membrane of the cavity, and it would have been necessary to go through this to expose them. No foreign body was seen or discovered in the clot. The hole in the artery was carefully closed with a continuous suture of fine catgut, while the surrounding tissues were drawn over with interrupted sutures of catgut. When the tourniquet was removed there was no bleeding except from one or two small vessels in the incision. A small tube was left in the cavity, the popliteal fascia re-sutured, and the incision then closed with interrupted silkworm stitches.

FIG. 100.—TRAUMATIC ANEURYSM OF THE POPLITEAL ARTERY.

X-ray photograph of the popliteal region in Case 3. It was taken after the last operation, and shows fragments of shrapnel still *in situ*.

PROGRESS. — The patient lay with the limb constantly on its outer side, and two days after operation a patch of pressure necrosis appeared over the external malleolus. It was then found that the area of supply of the external popliteal nerve was paretic both for motion and sensation. The wound healed by first intention, and at the end of a week there was no further hæmorrhagic discharge. By August 31 the patient was very well, and without pain or other symptoms; he could straighten the knee and bend it freely; the paresis was improving and the pressure patch nearly healed, a small slough having been cast off. An *x*-ray photograph made at this time (*Fig.* 100) showed many small fragments of shrapnel, and one, which was just about the centre of the popliteal space, larger than the others. [*Ref. No.* 49.]

REMARKS.—This case also shows the need of extreme care in dealing with patients in whom there is any possibility of injury to vessels. Probably the initial lesion was a contusion of the wall of the artery, with subsequent weakening and, finally, sudden rupture. The method of operating in two stages was deliberately chosen, and I think was justified by the subsequent course of events. Without the preliminary ligature it might not have been easy to secure the hole in the artery, and there would have been considerable risk of injury to the vein had it been necessary to expose and ligature the vessels at the site of the injury.

Case 4.—**Aneurysmal Varix of the Posterior Tibial and the Peroneal Arteries in the same Leg.**

This man was wounded at Hill 60 on April 23, 1915. While engaged in making an attack he was struck by a rifle bullet in the calf of the left leg. Almost immediately another bullet struck him in the left knee, and about ten minutes later he was wounded in the head by a fragment of shrapnel. The casualty happened on a Friday afternoon, and he lay where he fell until the Monday afternoon without either food or drink. On the latter day he was found by a Frenchman, who applied a field dressing and assisted him to the nearest ambulance. There was never much pain in the leg or much hæmorrhage, and he was unable to apply his own field dressing. He was able to walk with assistance; but after arrival at the hospital in the ambulance he became unconscious, and remembers nothing until a week after his arrival in England, on April 31. With the exception of a small ulcer on the heel he had no trouble with the leg, though he knew that there was a bullet in the neighbourhood of the knee. After nine weeks he began to get up and about, without any inconvenience from the leg. He was admitted to hospital on July 29.

He was found to be a healthy-looking man 36 years of age, though looking rather old for his years. He presented a healed depressed fracture over the frontal region; a healed scar to the inner side of the left patellar ligament, beneath which a bullet could be felt; and the healed wounds of entrance and exit of a bullet about the middle of the calf. There was a small ulcer the size of a shilling on the tip of the heel, and this was his only complaint, as it gave him some pain on walking. Because he had sustained a traversing wound of the calf in the neighbourhood of blood-vessels he was subjected to a systematic examination, but it was only on auscultation that signs of an aneurysmal varix were discovered. On further careful examination, the whole of the left leg below the knee was found to be slightly larger than its fellow, the calf measuring half an inch more in circumference than the sound limb. On very careful inspection in a good light, slight expansile pulsation was noticed over the back of the calf and extending about three inches above and below the site of the bullet wound. Over about the same area a thrill like the purring of a cat could be distinctly felt, and this was also present in front on either side of the tibia just opposite the wounds. A purring bruit could be heard over an area extending from the upper part of the popliteal space to the middle of the sole of the foot, but with greatest intensity in the neighbourhood of the track of the bullet and for a hand's-breadth below. This murmur was also plainly heard in front from the middle of the knee-joint to the middle of the dorsum of the foot, though not nearly so loudly as posteriorly. The anterior tibial artery was felt pulsating normally at the ankle, but it was doubtful if the posterior tibial could be made out. There was slight engorgement of the veins on the dorsum of the foot, and the toes and front part of the foot were slightly dusky. The leg and foot were not œdematous. There was no paresis or gross interference with sensation, but some confusion of thermal sensibility.

Operation, Aug. 9, 1915.—General anæsthesia was employed and a tourniquet used. With the patient on his back, an incision was first made to the inner side of the patellar ligament, and a complete bullet removed from a small cavity containing a little fluid. The wound was closed, a small rubber drain being left in. The patient was then turned over on his

Fig. 101.—Aneurysmal Varix of the Posterior Tibial Artery.

The vessels have been laid open side by side; the glass rod is introduced into the mouth of a dilatation of the vein opposite the communication.

Fig. 102.—Aneurysmal Varix of the Posterior Tibial Artery.

The vessels seen from the other side, showing the exact size of the communicating aperture in the artery.

Fig. 103.—Aneurysmal Varix of the Peroneal Artery.

The artery and vein are laid open side by side, showing the aperture of communication; the mouth of a small saccule in the vein is obvious. The figure also shows how the intima has retracted in the artery at the site of the injury.

face, and the back of the calf exposed. An incision eight inches long was made through the middle of the leg, with the track of the bullet as its centre. The gastrocnemius and soleus muscles were divided until the plane of the vessels was reached. There was no sign of extravasation, and the only guide to the vessels was the muscular veins, which were very much enlarged, so much so that, when divided in the muscles, they looked like portions of

cavernous nævi. The posterior tibial artery was completely covered by its accompanying veins, which were much dilated and beaded from the especial distention below the valves. When dissected free from the surrounding tissues, the artery with its veins formed a trunk fully as large as the little finger. The maximum dilatation was opposite the site of the bullet wound, but it extended upwards and downwards as far as the limits of the incision. There was no obvious sac and no extravasation of blood, though in the lower half of the wound there was a very little blood-staining, and the vessels were more adherent to the surrounding parts. The accompanying nerve bore its normal relation to the vessels, and did not appear to have been involved in the trauma. At either end of the incision the artery was exposed, and in this situation was found to be normal in size, but distinctly though slightly atheromatous. The artery and its veins were ligatured at either end and the intermediate portion excised, great care being taken to catch and tie every collateral branch; these appeared to be present in exceptional abundance, and were all dilated. It was then noticed that the peroneal artery was in the same condition. It was dealt with in the same way. After removal of the tourniquet there was smart venous bleeding from the lower end of the wound, but this was stopped by ligature, leaving the wound comparatively dry. A drainage tube was brought from the lower end of the incision, and the muscles were carefully sutured with catgut.

There were no troublesome after-symptoms, and recovery was rapid, the wounds healing soundly. By September 8 the man was able to be up and about. The leg was normal in every way, except that pulsation could not be detected in the posterior tibial artery at the malleolus.

In view of the atheromatous condition of the vessels the antecedent history was enquired into. In civil life the man was a labourer, not much addicted to alcohol, but he had suffered from 'venereal' disease seven years previously. An *x*-ray examination of the limb after the operation did not show any evidence of calcareous change in the remaining vessels.

The portions of vessel removed are shown in *Figs.* 101, 102, 103. [*Ref. No.* 50.]

Remarks.—No case could illustrate better the need of routine examination after gunshot injuries of the limbs, for the patient made no complaint beyond the 'sore heel' and the presence of the bullet in the knee. Although in this case a reconstructive operation would have been possible, I should not consider it necessary in dealing with vessels of this size. The conditions might be different in older subjects with less healthy arteries.

II.—ARTERIO-VENOUS ANEURYSM OF THE SUPERFICIAL FEMORAL VESSELS.

By Lieut.-Col. H. B. ANGUS, R.A.M.C.(T.)

The patient was admitted into the 1st Northern General Hospital on Nov. 6, 1914. He was hit by a piece of shrapnel (case ?) at Beaulieu, on Oct. 29, the piece of metal coming out again.

On admission, there was an expansile swelling situated at the upper part of Hunter's canal in the right thigh; a very distinct thrill was felt along the course of the femoral artery. On listening with a stethoscope, a loud, purring bruit was heard. There was no dilatation or pulsation to be felt in the veins. The patient complained of pain at the inner side of the right knee, and numbness of the toes; the limb was rather powerless. A diagnosis of arterio-venous aneurysm was made.

OPERATION, NOV. 17, 1914.—From Poupart's ligament a long incision was made in the course of the femoral artery. The sheath of the common femoral was opened, the artery isolated, and a temporary ligature applied. The common femoral vein was also exposed; in doing so a small entering vein was wounded close to the main vessel; this was ligatured. The common femoral artery was followed down to below its bifurcation, and the upper end of the superficial femoral was exposed. Then the lower end of the latter artery was cleared. Ligatures of catgut were applied to both ends, and as this stopped all pulsation and thrill, nothing more was done. The parts were very much matted together and infiltrated with blood. After taking off the temporary ligature from the common femoral, the wound was closed, no drainage being employed.

The wound healed per primam. On Dec. 10 the patient, able to walk, was discharged to his home in Plymouth. [*Ref. No.* 71.]

III.—SEVEN CASES FROM THE 1st SCOTTISH GENERAL HOSPITAL.

BY LIEUT.-COL. MARNOCH, R.A.M.C.(T.)

Case 1.—(Under the care of LIEUT.-COL. MARNOCH and CAPT. A. P. LOW.)

J. W., age 24, was admitted on Oct. 3, 1914. On Sept. 20 a rifle bullet had traversed his right thigh, entering the antero-internal aspect about the junction of the middle and lower thirds, and emerging posteriorly in the median line just above the middle of the condyles of the femur. Both wounds were small and almost healed. The wound of entrance was on the summit of a globular, pulsating swelling measuring quite four inches across. The pulsation was expansile, a thrill was present, and by stethoscope there was heard a loud roaring bruit, which was conducted along the track of the femoral vessels—upwards as far as Poupart's ligament and for a short distance on to the abdomen in the iliac region, and downwards to the lower limit of the popliteal space. Owing to œdema of the foot and leg it was impossible to ascertain whether there was pulsation either in the posterior tibial or dorsalis pedis artery. The great toe as far as the ball, and the terminal portions of the other toes, were gangrenous. There was defective sensation over the whole of the sole of the foot and back of the heel, and also over the distal portion of the dorsum from a point two inches above the web of the toes. The skin round the ankle was exceedingly susceptible to pressure, so that splints of all kinds had to be discarded in order that he might change the position of the limb frequently. Much pain was complained of, necessitating narcotics at night.

OPERATION, Oct. 20, 1915, by Lieut.-Col. Marnoch.—A vertical incision was made over the swelling, extending upwards along the track of the femoral artery, which was exposed and clamped by a Crile's clamp. The aneurysm was then opened and all loose clot cleared away; but owing to profuse hæmorrhage a tourniquet had to be applied to the limb a little below the groin. The sac wall consisted of condensed tissues lined by blood-clot, which was here and there organized. The communication between the artery and the sac was barely large enough to admit the tip of the index finger. After smearing the field of operation with sterile vaseline, the opening in the artery was closed by arteriorrhaphy, Crile's needles and finest silk being employed. On releasing the tourniquet at this stage, pulsation of the artery was restored and there was no leak at the line of suture. Further investigation of the relations between the artery and vein was deemed inadvisable on account of the extensive matting of the surrounding tissues. The sac wall, now much more pliable, was pressed gently downwards and sutured to the depth, thus obliterating the cavity; the rest of the wound was then closed.

On the tenth day healing was found complete, but a thrill could be felt along the track of the vessels for several inches on either side of the aneurysm. The swelling was gone, and there was no expansile pulsation. The most striking subjective symptom after operation was the relief from pain, which had been very severe at the site of the aneurysm and in the foot. The œdema disappeared, and the posterior tibial artery could now be felt pulsating at the ankle. The dorsalis pedis could not be felt. There was no extension of the gangrene, and while the smaller toes recovered, the great toe and part of the first metacarpal had to be amputated on Nov 6, 1914, by Capt. Low, who also divided the hamstring tendons on Dec. 8, and straightened the limb.

At the date of his discharge to his depot, Jan. 30, 1915, the thrill alluded to was still present, and it was evident that there was a communication between the artery and the vein. The area of defective sensation had somewhat increased, and the foot after walking assumed a dusky hue. He could get about, however, with comparative comfort, and he left for his depot with instructions to report himself for observation to the medical officer. At the date of his departure it was not considered advisable to subject him to a further operation. [*Ref. No.* 51.]

Case 2.—(Under the care of CAPT. A. DON.)

J. R., age 30, was admitted on Sept. 26, 1914. On Sept. 14 a bullet had passed through his left shoulder, entering the upper and front part and emerging in the axilla. The wounds were clean. There was considerable thickening along the track of the brachial artery, as also some induration along the anterior axillary fold. Sensation in the arm and forearm was unimpaired, but he could extend his fingers only slightly, while all power of flexion was gone. He complained of much pain, radiating from his shoulder to the tips of his fingers. By October the induration along the brachial artery was much softer, while the swelling in the axilla pulsated slightly and gave a feeling of fluctuation. An exploring needle was inserted into the latter, but only blood was drawn off, and a suture had to be applied in order to stop the

hæmorrhage from the needle puncture. During the next fortnight the swelling in the axilla increased in size, and much pain was complained of.

Operation, Oct. 17, by Capt. Don.—A curved incision was made from the centre of the clavicle to the anterior axillary fold, and the pectoralis major divided. Below the muscle was a fusiform, pulsating tumour, which, on being opened, discharged a quantity of blood-clot and bled very profusely. The hæmorrhage, which was controlled by digital pressure on the axillary artery above, was found to be coming from a longitudinal slit in the brachial artery, half an inch long by one-eighth of an inch broad. This was sutured with catgut, and the rest of the wound closed in layers, a drainage tube being lodged. The pulse after the operation was hardly perceptible, but the hand was warm, although bluish in colour. Some suppuration occurred in the centre of the wound, but otherwise the convalescence was uneventful, and he left on Dec. 9, 1914. [*Ref. No.* 52.]

Case 3.—(Under the care of Capt. A. Don.)

J. D., age 28, was admitted on Oct. 8, 1914, having sustained a shrapnel wound in the left clavicular region on Sept. 17. Up to the time of his admission his treatment had been conducted in France. Over the middle of the clavicle was a granulating wound discharging pus freely. Between this and the shoulder was considerable fullness, giving a feeling of fluctuation but unattended by inflammatory symptoms. Probing the wound showed a portion of the clavicle in the neighbourhood to be bare.

Operation, Oct. 11, by Capt. Don.—Through an incision made along the anterior axillary border, blood-clot was found lying under the pectoral muscles. Evacuation of the clot was followed by severe arterial hæmorrhage, which was controlled by pressure. The pectorals were then divided, and the source of the hæmorrhage was found to be the axillary artery, which showed a ragged tear on its outer side measuring half an inch by one-eighth of an inch. This was sutured. A piece of shrapnel was found in the clot lying below the wound in the vessel. The muscles and skin were then sutured. After operation the pulse at the wrist was very feeble and rapid. The wound of entrance continued to suppurate for a time, and there was also some septic infection of the operation wound; but he was much relieved of his pain, and the pulse at the wrist ultimately became stronger. He was discharged on February 15, 1915. [*Ref. No.* 53.]

Case 4.—(Under the care of Capt. A. P. Low.)

R. V., age 19, was wounded on March 28, 1915. A bullet had traversed his left thigh about the junction of the middle with the lower third, and lodged in his right thigh. From his account the wound in the right limb was attended by much sepsis and by secondary hæmorrhage, and eventually amputation was performed in the upper third of the femur by a circular method, no flaps being formed. When admitted to hospital, the amputation stump presented a clean, granulating surface measuring six inches in diameter. The wounds in the left thigh had healed, but in the bullet track was a pulsating swelling

about the size of a chestnut, giving the characteristic signs of a traumatic aneurysm of the femoral artery in Hunter's canal.

The general condition was exceedingly bad, and he ran a markedly septic temperature. A blood culture by Capt. Duncan showed a copious growth of streptococci after sixteen hours' incubation. Measures were taken to try to combat the septicæmia, but he died on May 22, 1915. The aneurysm was removed post mortem (*Fig.* 104). In addition to an aneurysmal sac there was a communication between the artery and the vein. [*Ref. No.* 54.]

FIG. 104.—TRAUMATIC ANEURYSM OF THE FEMORAL ARTERY.

The sac is laid open, the specimen being viewed from behind. A. Artery; V. Vein; S. Sac; T. Tendon; M. Muscle; N. Internal saphenous nerve.

(*Photograph by Professor Shennan.*)

Case 5.—(Under the care of CAPT. H. E. SMITH.)

R. T., age 19, was hit on May 9, 1915, by a bullet which traversed the upper part of the left thigh from before backwards. After being attended to at a clearing station, and subsequently at a base hospital in France, he was ultimately sent to his depot. Here the medical officer, while applying a fomentation over a boil on the left thigh, accidentally felt a thrill in Scarpa's triangle, and diagnosing an aneurysm, sent him to the 1st Scottish General Hospital, where he arrived on July 27, 1915. The patient stated that he had previously felt a purring sensation in his left thigh, but as he suffered no inconvenience he thought nothing about it.

The entrance scar was situated three inches downwards and inwards from the the pubic spine. The exit scar was just above the ischiorectal fold, at the same level as the anterior one, but a little nearer the median line. Slightly more pulsation was noted in Scarpa's triangle on the side affected than on the right side. Nowhere in the limb was there any alteration in the veins. The patient complained of a feeling of coldness over the inner aspect of the left leg below the knee, but no organic nervous lesion could be made out. A very definite thrill was detectable over an area extending from two inches below the wound, upwards along the track of the femoral vessels, and for a short distance into the iliac region. This thrill was also palpable about four inches inwards, and downwards and inwards, from the wound, and one inch outwards from it. A double murmur, the first sound coarse and roaring, the second blowing, could be heard from the iliac region, along the femoral vessels as far as the popliteal space. The point of maximum intensity of the

bruit was an inch internal to the cicatrix. The erect position did not affect the murmur. The posterior tibial and dorsalis pedis pulses were equal on both sides. In consultation with Lieut-Col. Marnoch, it was decided that as so little inconvenience was experienced no operation was at that time necessary. [*Ref. No.* 55.]

Case 6.—(Under the care of Capt. F. K. Smith.)

J. C., age 21, was struck by a stray bullet in Gallipoli on July 12, 1915. It passed through the right arm, and the injury was followed by profuse hæmorrhage. A dressing was at once applied, as also a rubber tourniquet to arrest the bleeding. About an hour afterwards he reached the base hospital, where the tourniquet was removed and the wound re-dressed. No further bleeding occurred during the voyage home, the only thing complained of being stiffness at the site of the injury.

He was admitted to the 1st Scottish General Hospital on July 28, when the wound of entrance was seen to be situated four inches above the internal condyle, and the wound of exit two and a half inches above the external condyle. Both were quite dry, and, with the exception of some ecchymosis, nothing else abnormal could be made out. On Aug. 5 he suddenly experienced excruciating pain in the arm at the level of the wounds, and almost at once noticed some swelling in the same region, which gradually increased in size. There was pulsation, although not expansile, over it, and a distinct bruit was to be heard. The radial pulse on the affected side was very small and easily compressed as compared with that on the left side. The pain continued very severe and interfered with his rest.

Operation, Aug. 7, 1915, by Capt. F. K. Smith.—An incision was made over the line of the brachial artery in the lower half of the arm. Under the deep fascia a mass of blood-clot was exposed, thick at the periphery, and softer, almost fluid, in the centre. On evacuating the clot a small vessel was discovered in the depth with about half an inch of its interior and lateral wall missing. Arterial suture being inapplicable, a double ligature was placed on the vessel and the intervening portion divided. The wound was closed in the usual way, and convalescence was uninterrupted. Since ligature of the vessel caused no alteration of the radial pulse, its identification was rather difficult; but it seemed to be the ulnar, the brachial having divided high up. [*Ref. No.* 56.]

Case 7.—(Under the care of Capt. F. K. Smith.)

W. S., age 37, was wounded in the lower part of the right arm by a rifle bullet in Gallipoli. The wound bled profusely, but stopped when the first dressing was applied. This dressing was kept on for three days, and thereafter changed every two days until he arrived in Aberdeen. There was no more bleeding, but about a week after the infliction of the wound the pain began to increase in severity, some swelling was observed, and he felt as if the arm would burst.

He was admitted to the hospital on Aug. 24, 1915, when the arm presented a small wound of entrance on the posterior aspect, one inch internal

to a point four inches above the olecranon, while the wound of exit, rather larger, was situated on the middle of the anterior aspect, one and a quarter inches above the bend of the elbow. Both wounds had quite healed, but there was still some discoloration of the skin in the neighbourhood. Over the inner aspect of the lower part of the belly of the biceps was a fusiform, pulsating swelling the size of a hen's egg, tender to touch, and very tense. The pulsation was not expansile, but there was a well-marked thrill and a bruit detectable all over the swelling, extending on to the bend of the elbow. The right radial pulse was not so full as the left. Tingling was complained of at the tips of the fingers, particularly the index and middle fingers, and there was some weakness of hand movements, although these were quite full. There was no coldness or wasting of the forearm.

OPERATION, by Capt. F. K. Smith.—An incision along the inner edge of the biceps exposed a mass of blood-clot, which was evacuated. The source of the hæmorrhage now came readily into view, in the form of the torn ends of the brachial artery. The tear was not completely across, but the anterior and lateral walls were absent for about three-quarters of an inch. Both ends were ligatured and the wound closed. So far the convalescence has been uneventful. [*Ref. No.* 57.]

IV.—FOUR CASES FROM THE 1st LONDON GENERAL HOSPITAL.

Case 1.—**Arterio-venous Aneurysm of the Left Temporal Artery and Vein.** (Under the care of LIEUT.-COL. D'ARCY POWER, R.A.M.C.(T.)

F. L. was admitted on May 24, 1915. He had been shot through the side of the head: the bullet entered through the inner side of the left external auditory meatus, destroying the floor of the orbit, and causing so much damage to the eyeball that it was extirpated at St. Omer.

On May 26 there was a sharp secondary hæmorrhage from the wound in the external auditory meatus, which was controlled by plugging.

The temporal artery was exposed on May 27, and was found to communicate with the temporal vein by means of an intervening adventitious sac. The bleeding occurred as a result of rupture of the sac. The artery and vein were ligatured above and below the sac, and the whole was excised.

The patient made a good recovery without further hæmorrhage, and was discharged on July 3, 1915. [*Ref. No.* 58.]

Case 2.—**Arterio-venous Aneurysm of the Left Posterior Tibial Artery.** (Under the care of LIEUT.-COL. D'ARCY POWER, R.A.M.C.(T.)

E. C. was admitted for open fracture of the left fibula in its lower third, the result of a shell injury on May 9, 1915. Secondary hæmorrhage on May 16 was arrested by plugging, but recurred on May 20.

The suppurating wound was explored, and the posterior tibial artery was found to be intimately connected with the veins; the artery had ulcerated at the point of union. It was exposed and was tied with the veins, above and

below the point of communication. The intervening portions of artery and veins were removed. The patient was discharged, without having had any further bleeding, on Aug. 19, 1915. [*Ref. No.* 59.]

These two cases appear to be worth recording, as they show that even arteries of secondary importance, like the temporal and tibial, are not exempt from the tendency to form arterio-venous aneurysms after injury.

Case 3.—**Traumatic Aneurysmal Varix of the Left Common Femoral Artery and Vein.** (Under the care of MAJOR W. MCADAM ECCLES, R.A.M.C.(T.)

J. K. was admitted on Jan. 30, 1915. He had been wounded by a bullet on Jan. 20. The entry wound was in the outer part of the upper third of the left Scarpa's triangle. There was no exit wound. *X* rays showed the bullet lying deeply among the adductor origins. There was discoloration of the skin from effused blood over the upper part of the femoral vessels. There was some swelling over the upper part of Scarpa's triangle, where there was pulsation.

On Feb. 1 the swelling was somewhat larger, and the pulsation more definitely expansile. The circulation in the foot was not affected, and the posterior tibial artery was easily palpable.

On Feb. 2 the swelling was much more marked, and pulsating vigorously. There was some congestion, and œdema of the left foot. A distinct continuous bruit could be detected by the stethoscope over the femoral swelling.

The common femoral vessels were exposed, and a small perforation was found in the artery and vein about three-quarters of an inch below Poupart's ligament; through this there was a passage of blood between the two vessels. The artery and vein were tied above and below the perforations.

Gangrene set in in the foot, and advanced, a demarcation line being ultimately formed round the upper third of the leg. On Feb. 11 amputation immediately above the femoral condyles was performed. Uncomplicated recovery followed. [*Ref. No.* 60.]

Case 4.—**Traumatic Aneurysm of the Left Popliteal Artery.** (Under the care of MAJOR R. COZENS BAILEY, R.A.M.C.(T.)

J. L. C. was admitted into the St. Bartholomew's Hospital section of the 1st London General Hospital with the following history. On May 13, 1915, while lying down, he was struck in the left calf by a shrapnel bullet. A skiagram showed no bullet. A diagnosis of 'bullet graze' was made. He was sent home for frequency of micturition. The graze on the calf had healed.

On June 4 patient complained of a lump that had come up during the night on the inner side of the left knee, and had caused him some dull aching pain, but had 'gone down' when he rubbed it. No lump could then be felt. On June 5 a soft, ill-defined thickening was palpable, deep to the left vastus internus. This, however, disappeared in the course of the afternoon. On June 6 a definite lump, pulsating and expansile, could be felt. Pulsation was stopped by pressure on the common femoral. On June 9 there was pulsation

in the popliteal space also. A skiagram showed a shrapnel bullet just above the apex of Scarpa's triangle. On June 15 digital compression of the common femoral was maintained by relays of dressers for five hours, and on June 30 for three hours.

As pulsation persisted, operation was undertaken on July 15. This comprised (1) removal of the shrapnel bullet, and (2) ligature of the superficial femoral at the apex of Scarpa's triangle. The injury was a leaking aneurysm of the popliteal artery. There was apparently no venous communication. The aneurysmal sac was not fully exposed.

Patient made an uninterrupted recovery. The foot was quite warm the night of the operation, and a pulse was felt in the dorsalis pedis artery on the fifth day. [*Ref. No.* 61.]

V.—FIVE CASES FROM THE 3rd WESTERN GENERAL HOSPITAL.

By Major CORNELIUS A. GRIFFITHS, R.A.M.C.(T.)

Case 1.—**Aneurysm of Subclavian Artery.**

F., age 28, was admitted on Dec. 7, 1914, with a small bayonet wound in the anterior axillary fold of the right side. The wound was apparently unimportant, and had practically healed on admission. Pain was complained of in the arm, but there was no paralysis. A fullness gradually appeared in the pectoral region, but no pulsation was apparent for a fortnight after admission. The pain increased in intensity, the swelling gradually became more pronounced, and pulsation became evident, giving rise to a diagnosis of aneurysm of the first part of the axillary artery.

Operation, Dec. 21, 1915.—The operation which I intended in this case was to place control ligatures upon the subclavian and brachial arteries, open the sac, and close the wound in the artery if practicable.

The third part of the subclavian was exposed by the usual supraclavicular incision. The artery had a bruised appearance, and on attempting to pass the aneurysm needle around it, free oozing of blood came from within its sheath. As pressure did not stop the oozing after one or two attempts, I thought the aneurysm had dissected up the sheath; so that part was packed, and the first part of the subclavian was exposed. A temporary control ligature of silk was placed around this (first) part of the artery. The commencement of the brachial artery was next exposed, and secured by a control ligature.

The next step was to expose and open the sac. This was done by splitting the pectoralis major. The sac wall was very ill-defined, and appeared to be little else than more or less laminated clot. A large amount of clot and fluid blood was removed preparatory to searching for the wound in the vessel.

At this stage the patient stopped breathing. Although the usual methods were applied for upwards of an hour, the patient died of respiratory failure. The heart continued to beat for some time after breathing stopped.

Necropsy.—Examination of the parts showed a wound in the third part of the subclavian artery, opposite the lower border of the first rib. The wound was upon the under surface of the vessel, and roughly the size of a split pea.

There was no definite aneurysmal sac, but the blood had dissected up and tracked along the sheath of the artery, as was discovered when ligature of its third part was attempted.

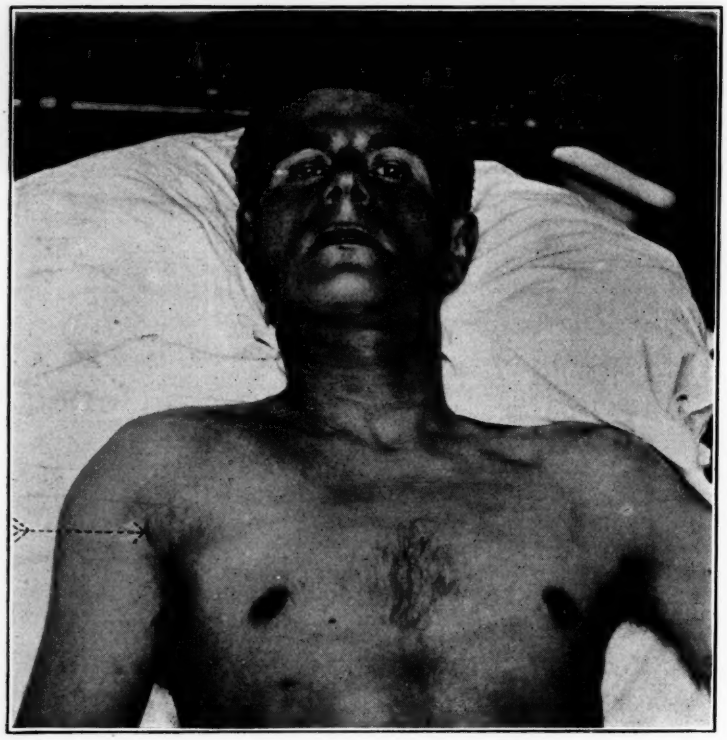


FIG. 105.—ANEURYSM OF THE RIGHT SUBCLAVIAN ARTERY, the result of a bayonet wound. The healed wound is indicated by the arrow.

Fig. 105 shows the scar of the bayonet wound, and also the swelling made by the aneurysm. The obliteration of the infraclavicular fossa is well shown. [*Ref. No.* 62.]

Case 2.—**Double Aneurysm of Popliteal Artery, simulating in some respects an Arterio-venous Aneurysm.**

J. W., age 22, was wounded at Ypres on May 9, 1915, by a bullet which passed through the popliteal region of the right thigh from side to side. He was treated at Boulogne and Cambridge, the wounds healing without any trouble. After getting about for a few days, he had pain in the back of the thigh (popliteal space) and felt throbbing there, which was worse on exertion.

On July 15 he was admitted to the 3rd Western General Hospital with a pulsating swelling occupying the right popliteal space. A very well-marked thrill could be felt over the swelling; it could not be detected below the level of the popliteal space, but was easily felt along the line of the femoral vessels and up to about two inches above Poupart's ligament. A loud bruit could also be heard within the same limits. Both thrill and bruit were most marked over the

swelling, ceasing abruptly at its lower end, and being conducted with diminishing intensity upwards. There was no apparent change in the veins of the leg. Pulsation was present in the posterior tibial artery.

OPERATION, July 27.—The popliteal space was opened up from behind by a median incision. The internal popliteal nerve was first found, and dissected free from the aneurysm sac which was beneath it. The aneurysm was next cleared, and it was found that there were two distinct aneurysmal sacs, one, the larger—about the size of a small Tangerine orange—upon the outer side of the artery, and the other, the smaller—the size of a filbert—upon the inner side, corresponding to the entrance and exit wounds made by the bullet, which had evidently passed through the artery (*Fig.* 106).

The larger sac was opened up, the clot removed, and the opening into the vessel closed with catgut before the smaller sac was discovered. In consequence of the double injury to the artery I tied the main vessel at the upper end of the popliteal space. No injury to the vein was discovered. The wound was closed with deep catgut sutures, and the skin by a suture of horsehair.

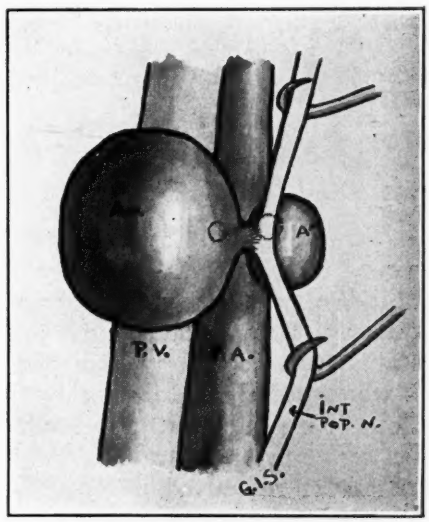


FIG. 106.—DOUBLE ANEURYSM OF THE POPLITEAL ARTERY. Semi-diagrammatic sketch taken by Lieut. Strachan at operation.

REMARKS.—The very marked thrill and bruit led me to suspect that this was probably a case of arterio-venous aneurysm, and it was this suspicion which helped to determine the nature of the operation—a direct attack upon the site of the injury, with the idea of removing the sac, cutting off communication between the vessels, and preserving the continuity of both if possible. The discovery of the two aneurysms, corresponding respectively to the entrance and exit wounds in the track of the bullet, was interesting, and would not have been made if the operation of distal ligature had been carried out.

The subsequent course has been normal as regards the wound, but the patient suffers occasional attacks of very severe pain in the foot at the roots of the toes. These are not accompanied by any apparent blanching or blushing in the skin. There is no evidence of nerve injury. [*Ref. No.* 63.]

Case 3.—**Aneurysm of Popliteal Artery, with Fracture of Femur.**

H., age 22, was admitted on May 10, 1915, with a fracture of the right femur, caused by a bullet which passed through the thigh at the junction of the middle and lower thirds, going from side to side. The wounds were clean, and a radiograph showed a long, splitting fracture of the bone.

No pulsation was noticed at first, but as the patient complained of

persistent pain in the neighbourhood of the knee-joint a few days after admission, examination led to the discovery of a pulsating swelling occupying the inner and posterior aspect of the thigh at the point where the femoral artery passes through to become the popliteal.

OPERATION, May 18.—The femoral artery was tied just below the middle of Hunter's canal. Catgut was used for the ligature and for uniting the deep structures, and the skin was closed with horsehair.

REMARKS.—The choice of the simple ligature operation was made in this instance, because (1) the case was complicated by the presence of a fracture, and (2) it was not possible to determine exactly whether the aneurysm was really a femoral or a popliteal, the site of the swelling covering the spot where the one passes into the other.

The fracture was treated without extension, as one had to take no risks with the circulation in the limb.

The patient was discharged on July 24, with a sound limb and less then an inch of shortening. [*Ref. No.* 64.]

Case 4.—**Hæmorrhage from a Large Vessel in or about the Base of the Skull. Internal Ligature of both Common Carotids.**

G., age 23, was admitted to the hospital on May 11, 1915, with a shrapnel wound through the head received at Ypres on April 25. After being wounded he fired twenty rounds, and then carried a wounded man upon his back a distance of a mile to the first dressing station. He remained at the dressing station two days, and was then transferred to Boulogne, when the bullet —which had entered just below the inner angle of the left orbit, passed directly from before backwards, and lodged under the skin of the neck about midway between occiput and mastoid (left side)—was removed without an anæsthetic.

When admitted at Cardiff under Capt. Greer, he had a septic wound just below the inner canthus on the left side, some (incomplete) facial paralysis, and complete deafness in the left ear.

The patient first came under my notice on May 15, at 11.40 p.m., when I saw him in response to an urgent call, suffering from the effects of profuse hæmorrhage from the wound, and especially from the nostrils and the mouth. Plugging the nostrils and the wound had failed to stop bleeding. He was blanched and suffering from the loss of much blood. To attempt finding the bleeding point was out of the question ; I tied the left common carotid below the omohyoid.

Fifteen days later he had a slight hæmorrhage from both nostrils. They were plugged with adrenalin gauze. On June 3, at 5.45 a.m., I was again sent for, as he had another profuse hæmorrhage from the nose and mouth. I tied the right common carotid, having seen that pulsation had not returned in the left carotid above the seat of ligature. I also plugged the posterior nares. Hæmorrhage again ceased for about three weeks. On June 28 it recurred, but ceased spontaneously.

I then had the patient removed to the nose and throat department under Major Paterson, who examined the nasopharynx with negative result, but in the antrum of Highmore found pus and bone débris, and a septic clot high up

and far back. Any disturbance of this clot is followed by a gush of blood which prevents further action. The exact site of hæmorrhage—whether the internal carotid within the skull, or possibly the cavernous sinus—has been impossible to discover up to the present. The condition of the patient is serious from loss of blood and sepsis.

The ligature of both common carotids has apparently had no ill effects as regards cerebral circulation. [*Ref. No.* 65.]

Case 5.—**Diffuse Aneurysm from Wound of Posterior Tibial Artery.**

T., a Belgian, age 28, was admitted to the hospital on Dec. 7, 1914, suffering from a gunshot wound of the left calf at about its middle, the missile having entered on the inner side and fractured the fibula before exit.

The case was taking a normal course for ten days after admission, when the patient complained of pain in the calf, and there was some swelling of the foot. The pain increased, and was evidently very great. The swelling occupied the calf, and was of an intense, 'wooden' hardness. A diagnosis of diffuse aneurysm was made, but the vessel was not determined.

Operation, Dec. 21.—A tourniquet was placed upon the thigh. An incision was made on the outer side of the calf, having the wound of exit for its centre. Much clot was removed from the leg between the superficial and deep muscles. The posterior tibial artery was found wounded, and was ligatured. A muscular branch near the broken fibula was also found divided and was also ligatured. Bleeding had stopped on removal of the tourniquet.

There has been no further trouble from bleeding. The patient is still in hospital, the fractured fibula having required some operations for the removal of necrosed bone. [*Ref. No.* 66.]

VI.—CASE OF TRAUMATIC ANEURYSM OF THE LEFT BRACHIAL ARTERY AT THE BEND OF THE ELBOW.

By J. W. GEARY GRANT, Cardiff.

Sergt. J. H., age 25, was admitted to the Welsh Metropolitan War Hospital on July 10, 1915, having been wounded ten days previously with shrapnel.

At the bend of the left elbow there was a pulsating swelling about the size of a hen's egg, the pulsation being definitely expansile. There was no enlargement of the veins. There was the small, healed scar of the wound of entry over the swelling, and about half-way up the inner side of the arm was an unhealed wound of exit in which was lying a piece of shell about the size of a sixpence, which was easily removed. Just above the left wrist was a scar about three-quarters of an inch long, lying transversely near the middle line, and on the inner border a small round scar, the aperture of entry of the bullet.

There was complete loss of sensation to prick and light touch over the whole of the palmar surface of the hand and fingers, and over the last two phalanges of the fingers and the last phalanx of the thumb on the dorsal aspect. The muscles of the hand appeared to be paralyzed, both those supplied

by the median and ulnar nerves, as the patient could not flex his fingers at the metacarpo-phalangeal joints or adduct or abduct them, and could carry out no movements of the thumb. The electrical reactions, however, were not tested. *X*-ray examination of the feet showed numerous pieces of shell or shrapnel—from twelve to twenty in various parts.

OPERATION.—As the aneurysm of the brachial was found to be increasing in size, I operated on it on Aug. 4, 1915. An Esmarch's tourniquet was applied, and the brachial artery was exposed just above the aneurysm. The anterior wall of the latter was continuous with the artery. I opened the aneurysm, scooped out about two ounces of clot, passed probes into proximal and distal openings, and with these as guides tied the artery above and below. The venæ comites were intact, but a slight puncture made in one was closed with a lateral ligature. The outer and posterior walls of the aneurysm were formed by the brachialis anticus. The median nerve was exposed, and appeared perfectly normal. Owing to the presence of a septic wound higher up the arm I did not expose the ulnar nerve, which is near the track of the piece of shrapnel removed from this wound. A drainage tube was kept in for forty-eight hours. There was a very little pus from the lower angle of the wound after a week.

On Aug. 24 the wound had entirely healed, and pulsation had returned in the radial artery at the wrist; but there was no return of sensation, nor movement of fingers or thumb. There was some inflammatory induration about the course of the ulnar nerve in the lower third of the arm.

REMARKS.—The piece of shrapnel had evidently cut away the posterior wall of the brachial artery, a false traumatic aneurysm forming. When discharged, Sept. 23, the patient could carry out all movements of thumb and fingers slowly and with some difficulty. There was therefore nearly complete return of voluntary movement, but there appeared no corresponding return of sensation. It is obvious that there was not complete division of the nerves, and the interruption of conductivity may have been due either to pressure at the bend of the elbow from the aneurysm or to partial division of the nerves above the wrist. [*Ref. No.* 67.]

VII.—THREE CASES FROM THE WELSH HOSPITAL, NETLEY.

BY LIEUT.-COL. A. W. SHEEN, R.A.M.C.(T.)

Case 1.—**Posterior Tibial Artery.** (*Inserted by kind permission of the* LANCET.)

The patient was wounded in the calf on Oct. 18, 1914, by a shell bursting near him. His own field dressing was applied within five minutes. He was admitted to the hospital on Nov. 8, three weeks after his injury. In the upper part of the right calf was a large pulsating swelling with thrill and bruit; there was no pulse in the posterior tibial at the ankle; the foot was somewhat cold and pale. Antero-posterior and lateral skiagrams showed shell fragments apparently in the medullary cavity of the tibia (*Fig.* 107). Scar of entry wound seen.

Operation was proceeded with on Nov. 13 (tourniquet). The aneurysm was laid open by a long vertical incision through the calf muscles. It was found that both the posterior tibial artery and vein were wounded; a number of branches and tributaries which occur in this situation had to be tied. A long length of the posterior tibial nerve was held on one side to safeguard it; a hole in the tibia was enlarged, and the shell fragments were found free in

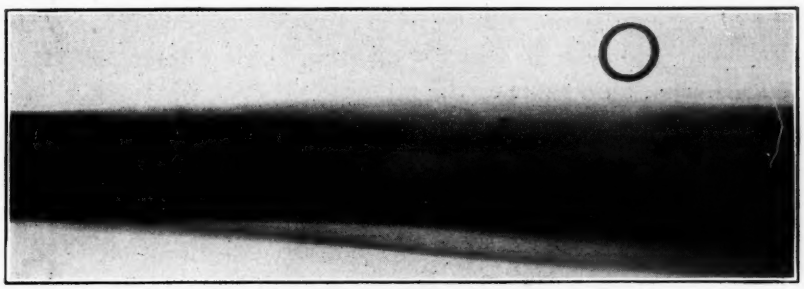


FIG. 107.—SHELL WOUND IN CALF CAUSING ANEURYSM OF POSTERIOR TIBIAL ARTERY. Fragments are seen in the medullary cavity of the tibia.

the medulla an inch and a half below the point of bone entrance. The wound was closed with drainage, and it healed aseptically, the man leaving the hospital on sick furlough on Dec. 14, recovered except for slight weakness of leg. He writes under date Sept. 25, 1915: "I have fully recovered, and passed fit for active service again. I am now awaiting draft." [*Ref. No.* 68.]

Case 2.—**Ulnar Artery.**

The patient received a bullet wound of the left forearm on April 14, 1915, at a range of about 400 yards. He immediately lost power in the hand.

He was admitted to the hospital, on April 22. The bullet had passed through the soft parts of the inner side of the middle of the left forearm, from dorsal to palmar aspects. The small wounds had healed. There was anæsthesia in the distribution of the ulnar nerve. Between the entrance and exit wounds was a swelling with expansile pulsation and a marked murmur. There was no pulsation in the ulnar artery at the wrist. There was much pain in, and below, the swelling.

OPERATION, April 28, by Lieut. T. Garfield Evans, R.A.M.C.—A tourniquet was applied, and through a vertical incision the flexor sublimis digitorum and flexor carpi ulnaris were separated, and a cavity found containing a soft blood-clot the size of a pigeon's egg. The clot was easily removed, and the ulnar artery was found with an opening in it, the venæ comites being also divided. The ulnar nerve was swollen and injected, and had evidently been pressed on by the blood-clot: the damaged portion was wrapped in Cargile-membrane. The ulnar artery was ligatured above and below the opening in it, and the veins tied. The wound was closed, with a tube left in, and healed in a week without infection.

The patient was discharged on furlough on May 25. Pain and pulsation had entirely, and the swelling nearly, gone. Power in the hand was good. Anæsthesia in the ulnar nerve distribution persisted. The man writes on Sept. 20, 1915: "I have not yet got the full use back. I cannot, as yet, grip things properly, but I have returned to duty at my depot, since June." [*Ref. No.* 69.]

Case 3.—**Common Carotid Artery.**

This patient was wounded by shrapnel on the right side of the neck on June 19, 1915. On admission to the hospital, on July 13, there was a healed wound of entrance on the back, over the right supraspinous fossa, three inches

FIG. 108.—SHELL WOUND IN NECK. Skiagram showing the shrapnel bullet *in situ*.

from the mid-line. Thence the bullet (shrapnel) had crossed the neck, and *x* rays showed it lodged on the left side of the root of the neck about an inch from the middle line (*Fig.* 108). The patient was fairly well, and walking about; there was a good deal of irritative 'barking' cough and watery expectoration; the voice was a hoarse whisper; there was some stridor. There was a pronounced localized murmur around the situation of the bullet, but no swelling. Deep pressure in this locality produced pain, and a feeling of hardness and resistance. Capt. E. A. Peters, R.A.M.C., kindly examined the larynx, and found left abductor paralysis.

On July 22, after *x*-ray localization, the bullet was cut down upon and easily removed by Capt. J. S. Rowlands, R.A.M.C. It underlay the origin of the left sternomastoid, and after the skin had been divided it was

felt and reached by direct incision. No signs of aneurysm were noted. Subsequent to operation, gradually increasing signs of tracheal obstruction developed, and on July 25 tracheotomy was performed by Capt. Rowlands. There was considerable relief; signs of bronchitis present gradually subsided, the tube was left out on Aug. 5, the wound quickly healed, and the patient was getting about, apparently almost well. Nearly a month later, signs of obstruction again developed, and on Aug. 31 there was a second tracheotomy, with much immediate relief; but dyspnœa soon returned, with signs of bronchitis at both bases, and the patient died, Sept. 3.

NECROPSY, September 4, by Lieut. W. MacAdam, R.A.M.C.—Body generally cyanosed. Left vocal cord strongly abducted. Tracheal mucous membrane markedly congested from level of cricoid cartilage downwards, the congestion extending into the smaller bronchi. Immediately below the left lobe of the thyroid is an aneurysmal sac the size of a tangerine orange, partly filled with laminated blood-clot, and proving on dissection to be sacculated, and connected with the inner side of the left common carotid artery by an opening a quarter of an inch in diameter situated half an inch from the origin of the artery from the aorta. The sac extends downwards to the superior aspect of the aorta, and inwards so as to slightly press in the tracheal wall, but with no great narrowing of the lumen. Posterior to the sac is a patch of cicatricial tissue in which the left pneumogastric nerve is embedded.

In the bronchi and bronchioles the mucous membrane is swollen, and covered with thin purulent secretion, while the lungs are in a condition of considerable œdema. The right middle lobe and the lower part of the right lower lobe show pneumonic patches. There is recent pleurisy over both lungs.

Other organs are markedly congested, otherwise normal.

The lung condition is considered to be the cause of death. [*Ref. No.* 70.]

VIII.—ARTERIO-VENOUS ANEURYSM OF THE CAROTID ARTERY.

BY LIEUT.-COL. BOND, R.A.M.C.(T.), AND CAPT. MICHELL, R.A.M.C.(T.)

G. B. was wounded in the neck by a rifle bullet at Ypres on April 24. The bullet entered through the sternomastoid, just below the level of the angle of the jaw, on the left side. It traversed the deep tissues in front of the spinal column, and emerged just above the clavicle on the right side, at the outer border of the sternomastoid muscle. In its passage it wounded the carotid artery at its point of bifurcation into internal and external carotids, and also the internal jugular vein and the œsophagus. On the receipt of the wound the patient immediately vomited a large quantity of blood, but this soon subsided. He was treated at the 2nd Canadian Hospital at Tréport, landed at Dover on May 14, and reached the 5th Northern General Hospital at Leicester the same day.

On admission, the wound of entry was completely healed, and that of exit nearly so. An *x*-ray photograph showed the absence of any foreign body. There was a swelling in the neck under and in front of the sternomastoid on the left side, at the level of the upper border of the thyroid cartilage. The

swelling was somewhat ill-defined, with a slight expansile pulsation and a very marked thrill, which was conveyed upwards and downwards in the direction of the vessels, but chiefly in the upward direction. There was no difference in the colour of the neck and face on the two sides. The pupils were equal and reacted equally to light. The grasp of the hands and the radial pulse were also equal on both sides.

The patient stated that after recovering from the shock and the loss of blood, he began to experience noises in his head three days after the injury. He was also slightly deaf in the left ear, and had a sensation of dropping through the bed, and of giddiness on rising into the upright position. He was abnormally conscious of each beat of the heart. His sight was not affected, nor was he psychically disturbed, his memory being good, though he soon became mentally and physically tired on slight exertion. He also suffered from profuse perspiration on exertion, and from some difficulty in swallowing.

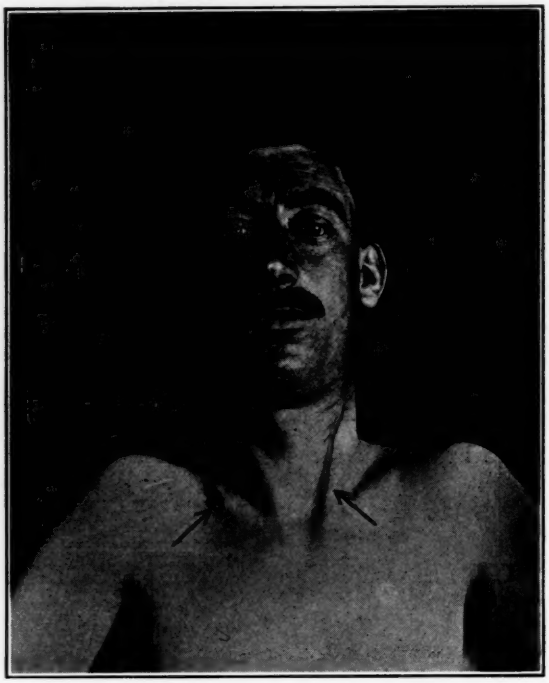


FIG. 109.—THE PATIENT AFTER THE HEALING OF THE OPERATION WOUND. The line of the incision in the neck, and the position of the exit wound on the right side, are both indicated by arrows.

Six weeks later, the patient's general health being good, and little or no improvement having occurred in the sense of giddiness and noises in the head, it was decided to operate.

OPERATION, June 24, by Lieut.-Col. C. J. Bond. — A long incision was made along the anterior border of the left sternomastoid, and the jugular vein and carotid arteries were exposed and isolated above and below the swelling. The vein was fully the size of the thumb, and very turgid. The large common facial vein was ligatured off where it entered the common trunk, and the jugular itself was tied above and below the swelling. The common carotid was doubly ligatured and divided low down in the neck; it was then followed upwards into the swelling, and the position and relation of the vagus to the swelling and to the main vessels were carefully defined. It was now found that the aneurysmal sac which intervened between the artery and vein sprang from the common carotid, opposite the origin of the external and internal carotids; the latter vessels were ligatured and divided, and the sac with its attached vessels was removed, except at the inner and posterior part, where it was necessary to leave a small portion of the wall which was intimately and

densely attached to the œsophagus where this canal had been perforated by the bullet. The recurrent laryngeal nerve was not seen; the vagus lay exposed, but not injured, for about three inches in the floor of the wound.

The wound was closed with adequate drainage, and rapid healing took place. On July 16 the patient was up and about. The noises in the head have practically gone, though he still gets slight noise in his right ear when he closes his eyes tightly, or yawns, or stoops down. He easily gets tired on exertion. Six consecutive tests with the dynamometer gave, for the left hand, 28, 21, 22, 24, 20, 20 kilos; for the right hand, 27, 27, 26, 26, 25, 25 kilos; the patient is right-handed. A strong spiral wire spring stretched with the arms fully extended, to test the strength of the shoulder and elbow muscles, was about equally extended on both sides. The localization of a touched spot on each upper limb by the forefinger of the opposite hand is about equally accurate on both sides. The patellar jerk is slightly less vigorous in the right leg than in the left; but when tested during voluntary effort, as by the forcible separation of the clasped hands, the jerks become equal. Sensation to cotton-wool contact is equal on both sides. Patient is cheerful. He converses intelligently about his wound and his previous and present surroundings. There is no sign of any psychical disturbance or interference with speech or writing. He experiences a little tendency to weakness in his legs after walking.

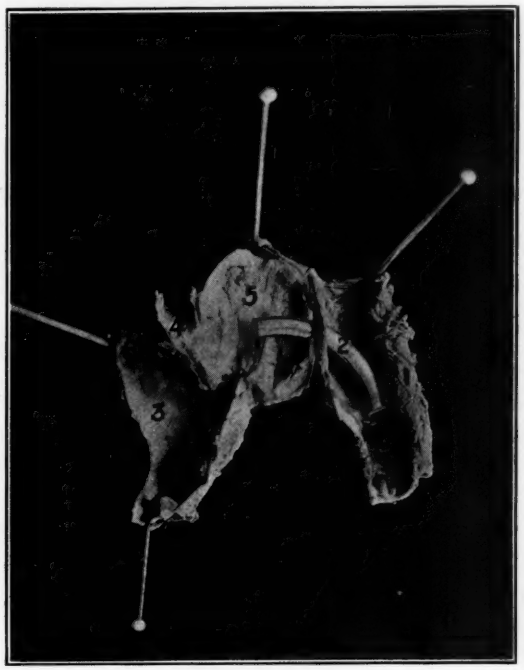


FIG. 110.—THE PARTS AS REMOVED AT THE OPERATION, AFTER DISSECTION, WITH THE ANEURYSMAL SAC AND THE VESSELS LAID OPEN. The piece of curved wire passes from the upper part of the sac through the opening into the jugular vein. The external carotid is seen between the internal carotid and the sac. The common facial and lingual veins entered the jugular on its anterior surface where it is laid open; they have been removed.

(1) Wall of jugular vein laid open; (2) Wire passing through opening joining cavity of aneurysm with vein; (3) Common carotid artery laid open; (4) External carotid artery; (5) Cavity of aneurysm; (6) Internal carotid.

On August 7 he was discharged convalescent to the Canadian Hospital at Monks Horton.

REMARKS, by Lieut-Col. C. J. Bond.—This case is interesting from two points of view, surgical and physiological.

Surgical.—The absence of infection, though the œsophagus was wounded by the bullet, is noteworthy. This, however, is in accordance with what has happened in other cases of injury to this contractile tube, with its thick

muscular walls, when allowed to remain quiescent and undistended after injury until repair has taken place.

It might be thought that an attempt should have been made to save the jugular vein by suturing the lateral opening in its walls after ligature of the arteries and excision of the aneurysmal sac. No doubt the problem of the cerebral circulation must be taken into account in dealing with these cases; but the technical difficulties arising from the unequal size of the vein above and below the opening, and its distended condition, would have been serious, together with the possibility of a catastrophe in case the suture line should give way. I think the recovery of the patient fully justified the procedure adopted.

Physiological.—The question arises to what extent the symptoms of disturbance in the cerebral circulation before operation were due to back pressure in the vein, or to diminished supply of arterial blood, or to both causes. The distended condition of the jugular vein above the communication with the artery, and its more normal size below, show that the heightened pressure in the vein was due to the arterial blood-stream meeting the venous return current.

An attempt was made on recovery from the operation to ascertain the effect on the brain of the cutting off of a large portion of the arterial blood-supply on the left side. It is quite likely that further delicate ergographic and other tests would have shown that distinct disturbances had been caused, and that the psychophysiological reactions were not equal in the two hemispheres. Such evidence as was obtained, however, goes to show that the deprivation of arterial blood on the left side was largely counterbalanced by the free collateral circulation inside the skull; but in this connection we must remember that the patient was a young man in good general health. The effect on the deep reflexes was interesting in connection with Hughlings Jackson's views concerning the movements on the paralyzed side in cases of hemiplegia. [*Ref. No.* 72.]

IX.—NINE CASES FROM THE 2nd NORTHERN GENERAL HOSPITAL.

Supplied by the D.M.O. of the surgical side.

Since the opening of this hospital, up to and including Aug. 18, 1915, twenty-three cases of traumatic aneurysm have been operated on. The arteries affected were as follows: femoral 5, posterior tibial 4, popliteal 3, axillary 3, brachial 3, facial 2, subclavian 1; 2 could not be traced. Brief accounts of nine cases are appended.

Case 1.—Aneurysm at the Apex of the Axilla in the Region of the Subclavian Artery.

W. R., age 29, was admitted on May 29, 1915, for a shrapnel wound of the right shoulder, received at Festubert on May 15. There was a wound of entrance beneath the right clavicle, but no exit wound. An *x*-ray examination made by Capt. Stansfield, R.A.M.C.(T.), showed a piece of shrapnel—

which had apparently passed through the lung—situated in the neighbourhood of the right scapula.

Operation, June 5, by Major Knaggs.—This was undertaken for secondary hæmorrhage from a traumatic aneurysm at the apex of the axilla. During the course of the operation two pints of saline were injected intravenously and two pints subcutaneously. An incision eight inches long was made from the middle point of the posterior triangle of the neck to the lower border of the anterior fold of the axilla, following the line of the axillary artery in the latter part, and running through the wound, which lay at the lower border of the clavicle. The supraclavicular triangle was dissected out until the subclavian artery could be digitally compressed. Both pectoral muscles were then divided, and a large clot was turned out of a cavity at the extreme apex of the axilla. When this was done severe hæmorrhage took place, and compression of the subclavian artery had no effect. The finger was felt to pass through a hole, apparently in an intercostal space, and was able to control the hæmorrhage. The middle of the clavicle had already been removed to give more room. The wound was now plugged, the inner portion of the clavicle excised, and the cartilage of the first rib taken away, as it was thought that the hæmorrhage proceeded from the intercostal branch of the internal mammary artery. On working between the pleura and the rib, it was realized that there was no penetrating wound of the chest; and on turning the soft parts sideways, by dissection from the chest wall, the seat of the bleeding was reached, and the bleeding points were clipped and tied; a large nerve was isolated from the strand in which the vessels were found. It was uncertain which the punctured vessel was: it was thought that it might be the subscapular. The large pectoral muscle was sutured, and the patient being at this time in a very bad condition, he was transfused; he also had an attack of syncope, from which he was restored by artificial respiration.

On June 8 there was commencing gangrene of the fingers; it was superficial, and the hand was quite warm, but there was no ulnar or radial pulsation. There was induration along the course of the vessels both in the upper arm and forearm. The patient had a distressing cough during the night, with some blood-stained sputum.

On June 10 the arm was much swollen, and there was no pulse at the wrist, but the skin was quite warm. There were blood bullæ on the dorsum of the hand. On the previous day a blister or gangrenous patch formed in front of the centre of the triceps, with discharge of pus. There was also a gangrenous area over the internal condyle, obviously due to pressure. The axillary wound was cleaner and not so offensive.

On June 17 incisions were made in the arm, at the elbow, and in the ulnar region of the forearm, much pus and necrosed cellular tissue coming away. The left ankle-joint now showed signs of trouble, and morphia had to be given to relieve the pain. On the following day an incision was made in front of the external malleolus under local anæsthesia, and pus—some of which had been previously extracted by a syringe—flowed out. During the night some fluid escaped from the site of the subcutaneous infusion; this fluid was grey and serous in character—quite different from the pus found in other parts. An

attempt was made to inject collargol into a vein; but owing to the coarseness of the needle the vein was not entered, and the collargol escaped beneath the skin, the operation being discontinued.

On June 21 the arm wounds were looking much better. There was gangrene of the tips of the third, fourth, and fifth fingers, though the depth of the gangrene was doubtful. Feeling was good in the arm, and also in the hand; the latter, where not affected by gangrene and open sores, looked quite healthy.

On July 8, under ether, the ankle-joint was drained by several incisions, and a tube was put right through from back to front, other tubes also being inserted, An abscess of the right buttock, extending across the right half of the sacrum, was opened by two incisions and drained by a tube.

On July 18 a small abscess over the front of the left thigh was opened; bluish pus was found, and also some sloughing of the subcutaneous tissue. On July 19 bacteriological examination showed intense concentration of *B. pyocyaneus* in the pus from the ankle; this was the first appearance of *B. pyocyaneus* in this case. Sixty minims of the stock vaccine were given.

On Aug. 7 incisions were made into the swollen area at the back of the right shoulder and arm; no pus was reached.

On Aug. 20 it was found that the arm below the elbow was anæsthetic. This anæsthesia was not limited to any single nerve, but involved them all. The condition may be compared with that existing on June 21.

Oct. 5, the patient is in hospital, and sat up to-day for the first time. [*Ref. No.* 87.]

Case 2.—**Arterio-venous Anastomosis of the Axillary Vessels, with Traumatic Aneurysm of the Subscapular Artery.**

R. R., age 22, was wounded at Ypres on June 16, 1915, by a rifle bullet, which entered the right shoulder two inches below and one inch internal to the coracoid process, and emerged immediately below the posterior fold of the right axilla. Patient was in bed for three days, and the wound was quite healed in a week.

On June 2 he was admitted to the hospital, and thought he was quite well. On examination, a slight pulsating 'fullness' was found under the outer third of the right pectoralis major. A very marked thrill was present, reaching from just above the right clavicle, through the axilla, as far as the internal condyle of the humerus. A loud bruit* was also present in these areas. There was no dilatation of superficial veins. The right radial pulse was slightly diminished. Sensation in the little, ring, and part of the middle fingers was somewhat lessened; but with rest in bed all these signs diminished very much.

Operation, July 4, by Capt. Richardson, R.A.M.C.(T.)—A transverse incision, parallel with and two inches below the clavicle, was made, reaching from its inner third outwards into the deltoid. The clavicular and sternal

* The bruit was very remarkable. It was continuous, and might be compared to the noise going on in a foundry with the regular thuds of a steam hammer.

origins of the pectoralis major were separated, and the nerve supply preserved. The first part of the axillary artery was cleared, and a temporary ligature applied; the first part of the axillary vein was much dilated. The vessels were then dissected clear down to about the origin of the subscapular artery. Just above this point a communication about the size of the diameter of a lead pencil was found between the axillary artery and vein. Immediately below this, at the origin of the subscapular artery, a traumatic aneurysmal sac the size of a walnut was discovered. The temporary ligature round the first part of the axillary artery was now tightened, and the first part of the axillary vein, which was greatly distended, was ligatured. The artery and vein below the aneurysm were cleared, and a ligature applied to each. The aneurysmal sac at the origin of the subscapular artery was then opened, and smart hæmorrhage occurred, which was only stayed by ligaturing the subscapular artery itself about an inch distal to its origin from the axillary artery. The axillary artery and vein with their communication, together with part of the subscapular artery with its aneurysmal sac, were then removed *en bloc*. The muscles were brought together, and the wound closed. A stab puncture was made in the axilla for the insertion of a tube drain. The day after the operation no pulsation could be felt in the radial artery. The wound healed by first intention, and the tube was removed on the third day.

PROGRESS.—On July 26 no pulsation, thrill, or bruit could be made out about the axilla or shoulder. The radial pulse could not be felt. Movements at the elbow and wrist-joints were normal; the fingers and shoulder were a little stiff.

On Aug. 25 patient was apparently normal, except that the movements at the shoulder were slightly impaired. The sensation and movements of the fingers were normal. The radial pulse could not be felt. [*Ref. No.* 88.]

Case 3.—**Traumatic Aneurysm of the Axillary Artery.**

J. M., age 29, was wounded at Neuve Chapelle on June 22, 1915, by a rifle bullet which entered behind at the lower angle of the left scapula. The exit wound was immediately to the outer side of the head of the left humerus. On June 30 he was admitted to the hospital. The wound of exit was then suppurating freely, and the whole shoulder and arm were swollen, bruised, and painful. The temperature was 99·4°. There was no movement in the fingers, wrist-drop was present, radiating pain was felt down the arm, and sensation was apparently lost in the thumb and first and second fingers.

On July 4 a large traumatic aneurysm was discovered in the left axilla, with pulsation and systolic bruit. There was much œdema and induration of the shoulder, upper arm, and axilla, and there were radiating pains down the arm to the elbow.

OPERATION, July 5, by Capt. Richardson.—Under ether anæsthesia, a transverse incision was made parallel with the clavicle, reaching to the upper arm. The sternal and clavicular portions of the pectoralis major were separated, and the pectoralis minor was divided transversely. Vessels and nerves were welded together by firm adhesions; owing to the great induration much difficulty was encountered in exposing the first part of the axillary

artery. This was eventually done, and a temporary ligature passed round the artery about an inch below the outer border of the first rib. The vessels below were then freed, and a large sac was discovered involving the third part of the axillary artery and spreading outwards on to the head of the humerus. The sac was about two and a half inches long by an inch and a half broad, and firmly embedded in indurated tissues. The temporary ligature on the first part of the axillary artery was tied. Owing to the great induration of the surrounding tissues, and the general septic condition of the wounds, it was not considered advisable to open the sac, and for the same reason the vessel below the sac could not be isolated. The sternal portion of the pectoralis major had to be partly divided transversely to allow of free dissection; the muscle was carefully sutured and the wound closed. A tube drain was left in the axilla, and brought out through a separate puncture wound. No pulse was felt in the radial artery on the evening of the operation.

On July 7 there was still some discharge from the tube. The radial pulse was faintly felt. During the following week the wound healed, the tube was removed, and the discharge ceased. The radial pulse was just discernible. There was no pulsation in the axilla. There appeared to be some improvement in the movements of the fingers, and the hand could be slightly raised. Sensation also improved. The œdema of the shoulder was much less, and the induration was disappearing .

On Aug. 25 all œdema and induration about the shoulder had disappeared, and no pulsation could be made out. The radial pulse could not with certainty be felt. The fingers could be raised from the splint. There was no pain. Impairment of abduction at the shoulder-joint was present.

The patient is still (Oct. 5) in hospital for supply of artificial teeth. [*Ref. No.* 89.]

Case 4.—**Varicose Aneurysm of the Femoral Artery.**

H. W., age 27, was shot on July 29, 1915, at Ypres, probably at about four hundred yards range. The bullet passed right through the left thigh. The entry wound was situated just below the middle of the thigh, and over the line of the femoral artery; the exit wound was at about the same level behind the limb.

When the patient was admitted, on Aug. 12, the anterior wound was healed; from the posterior wound there was a little serous discharge. On placing the flat hand over the former, a fine thrill was felt continuous, but with rise and fall in intensity, like a kitten purring. Auscultation showed a corresponding loud blowing bruit. The left limb was colder than the other. No distended veins were visible. A pulse could be felt in the anterior and posterior tibial arteries. Under the anterior wound was a small indurated area with expansile pulsation. The patient complained of jumping pain at the inner side of the knee, and numbness down the inner side of the leg and ankle. A wound of the femoral artery and vein in Hunter's canal, with division of the long saphenous nerve, was diagnosed.

During the following week, the patient complained of increasing pain in the region of the wound, and the aneurysm became larger.

OPERATION, Aug. 18, by Capt. W. Gough, R.A.M.C.(T.)—Under chloroform and ether, an incision about eight inches long, with its centre at the wound of entry, was made along the line of the artery. Artery and vein were exposed and ligatured above and below the injured parts, which were dissected out. There was a small cavity not larger than a hazel nut between the wounded artery and vein. It was noticed at the end of the operation that the long saphenous nerve was cut. The wound was stitched up, except for a drainage tube reaching down to Hunter's canal.

After the operation the patient was fairly comfortable, and the circulation in the great toe was satisfactory. On the following day there was much pain in the region of the wound, and the temperature was 102°. Two days later, on Aug. 21, when the wound was dressed, pus was found oozing from the upper part of the incision. Clips and stitches were removed and the upper half of the wound was laid open, and fomentations were applied.

On Aug. 31 the wound was healing well, and the drainage tube was removed. The patient was still in hospital on Sept. 7. [*Ref. No.* 91.]

Case 5.—**Aneurysmal Varix of the Popliteal Artery.**

J. H. W., age 20, was admitted to the hospital on April 27, 1915, with a shrapnel wound of the buttocks. There was a ragged wound of the right and an abrasion of the left buttock, a small abrasion below the back of the left knee, and much discoloration and some swelling in the left popliteal space. A loud systolic murmur and 'machinery' bruit could be heard over the swelling, there was expansile pulsation at the lower end of the popliteal space, and a well-marked diffuse thrill was present.

OPERATION, May 26, by Capt. S. W. Daw, R.A.M.C.(T.)—An incision was made over the length of the popliteal artery. The latter was exposed above the lesion, for temporary control, and the injured region was displayed. A condition of aneurysmal varix was found, with a false sac on the side of the vein opposite to the artery; this indicated that the vein had been pierced from side to side. The vein was detached from the false sac, which was left alone. Both vessels were ligatured above and below, and after some small communicating branches had been ligatured, the intermediate portion was removed.

Later on the patient was discharged on furlough, afterwards going back to light duty. [*Ref. No.* 93.]

Case 6.—**Aneurysm of the Popliteal Artery.**

D. P., age 21, was wounded by shrapnel at Neuve Chapelle on March 10, 1915. A shrapnel bullet had entered the outer side of the left knee, and was removed at the apex of Hunter's canal. Patient was admitted to the hospital on March 19, when the knee-joint was swollen and painful; fomentations were applied. Aneurysm was suspected, though the sac was then small. By March 30 there was distinct evidence of a popliteal aneurysm. There was a pulsating mass the size of a tangerine orange in the line of the artery, the pulsation being expansile, and a distinct systolic thrill and murmur over the sac.

OPERATION, April 3, by Lieut.-Col. Dobson, R.A.M.C.,T.—One inch of the popliteal artery was excised. There was a ragged hole in the vessel, involving its entire circumference.

The patient was sent to the Auxiliary Military Hospital at Bawtry, and was ordered light massage and passive movements. Under this treatment he improved, and his leg became straight. On May 17 he had an attack of acute pain in the knee, with some swelling in the joint and slight fever, and the massage was temporarily stopped. On May 29 he was sufficiently recovered for the treatment to be continued, though fluid returned into the joint whenever passive movements went far enough to straighten the knee.

He returned to Leeds in July, much improved and walking about, though the scar was a little tight. On July 22 he was discharged for a fortnight's furlough, to be followed by light duty. [*Ref. No.* 94.]

Case 7.—**Aneurysm of the Femoral Artery.**

D. J. G., age 22, was admitted to the hospital suffering from a bullet wound of the left thigh received at Ypres on April 27, 1915. An entrance wound was seen to the inner side of the line of the femoral artery, and an exit wound in the middle line behind, four inches below the buttock fold. There was an indurated swelling about two and a half inches long in the course of the vessels, just below the apex of Scarpa's triangle; pulsation and a faint systolic bruit could be detected. There was a slight discharge from the wounds. The temperature was 101°.

On May 8 there was slight hæmorrhage from the exit wound, evidently a leakage.

OPERATION, May 8 by Major R. L. Knaggs.—An incision was made over Hunter's canal. The artery was exposed above the swelling, and ligatured. The false sac was removed, and a semicircular hole in the inner side of the artery exposed. The artery was divided above and separated downwards. The trunk, now exposed below the aperture, was ligatured. The injured part was next removed. A drainage tube was passed from the posterior wound up to Hunter's canal, the wound being left open and packed. Two pints of saline were given by transfusion.

The operation was not severe; but as the patient was being put upon the table, profuse bleeding took place from the posterior wound. The vessel was at once compressed and a tourniquet applied, but he had lost a good deal of blood. On the following day, in spite of active treatment, he was still suffering from the effects of shock and hæmorrhage, and on May 10, notwithstanding subcutaneous infusion, the shock seemed to increase, and he died about 3.30 p.m. The foot was still very cold and purple. [*Ref. No.* 95.]

Case 8.—**Popliteal Aneurysm.**

J. W., age 28, was admitted on April 1, 1915, with a bullet wound of the knee. Three days later he developed pain and a pulsating tumour over the inner side of the thigh at its lower end.

OPERATION, April 4, by Major Coupland, R.A.M.C.(T.)—The femoral

artery in Hunter's canal was exposed and ligatured. The sartorius was then divided, and the aneurysm exposed. The wound in the popliteal artery was localized, the artery clamped above and below and divided, and the wounded portion removed. A hole was found in the wall of the artery. The vein was not disturbed. The wound was closed with silkworm-gut, and a drain inserted.

On April 11, as there was some suppuration, the wound was laid open and allowed to granulate up.

On July 10 the wound had healed. [*Ref. No.* 96.]

Case 9.—**Aneurysm of the Facial Artery.**

F. L., age 22, Belgian, was admitted to the Leeds General Infirmary on Oct. 30, 1914, suffering from shell wounds of the face, forearm, and buttock, received some fourteen days previously. About a week after admission, a swelling the size of a walnut suddenly developed beneath a healed wound immediately in front of the insertion of the left masseter muscle. On examination, marked pulsation could be made out.

OPERATION.—An oblique incision was made in the neck, and the facial artery ligatured half an inch from its origin. This wound was then closed, and the aneurysmal sac opened. Hæmorrhage occurred from the distal end of the artery. All clot was turned out of the sac, which was packed with gauze; the hæmorrhage then ceased.

The gauze was removed after three days. No further hæmorrhage occurred, and the wound gradually healed. It was some weeks before the patient was discharged from the hospital, as the wounds in the elbow and buttock continued to suppurate for some time. [*Ref. No.* 97.]

X.—ELEVEN CASES FROM THE 2nd WESTERN GENERAL HOSPITAL.

Two Cases of Popliteal Aneurysm. (Under the care of CAPTAIN P. R. WRIGLEY, R.A.M.C.(T.)

Case 1.—Private T. was admitted on Sept. 13, 1914, suffering from shrapnel wounds received on Sept. 10. There were numerous punctured wounds of the right calf and thigh. He came under my care ten days later, when I found the wounds healed with the exception of a sinus in the calf. On the evening I took charge of him his temperature ran up to 103°, and his calf became very tender and swollen; this was explored under an anæsthetic, and a few drachms of pus was evacuated. For the next few days he improved, and then his temperature, which had fallen to normal, ran up to 100° in the evenings. He now complained of pain in the thigh; on examining this region I found a large tender swelling in the lower and inner third of the thigh; on the surface of the swelling was a healed shrapnel wound. I concluded, perhaps rather hastily, that this was another abscess, and proceeded to open it under an anæsthetic. An incision three inches long was made over the swelling; no sooner was the skin divided than a large clot of blood presented, and on

this being extracted there was a sudden gush of profuse arterial hæmorrhage, which was immediately controlled by the anæsthetist compressing the femoral artery in the groin. A tourniquet was then put round the thigh, and the remainder of the clot sponged away, when the popliteal artery lay exposed at the bottom of a large cavity. The artery was seen to be almost completely severed close to its commencement immediately beyond the opening in the adductor magnus, so that it was found necessary to divide a portion of this muscle in order to secure the artery, which was then ligatured with stout catgut above and below the laceration in its walls. The tourniquet was released and no arterial hæmorrhage occurred; but there was a conconsiderable amount of oozing from veins, for which it was found necessary to lightly pack the wound with gauze, the wound being stitched together with silkworm gut. The packing was removed after two days. The wound discharged serum for about a fortnight, and then healed.

The foot and limb remained warm, and there was never any suggestion of gangrene; but the patient developed a pressure-sore on the heel, which was very callous, and after healing broke down on several occasions, so that all splinting was impossible and some contraction took place at the knee and in the tendo Achillis. This was largely overcome by massage and movement, but eventually it was necessary to do a tenotomy of the tendo Achillis.

When examined recently, pulsation was present in the dorsalis pedis artery but not in the posterior tibial at the heel; this suggests that there had been damage to the anastomoses, possibly by the many shrapnel wounds in the calf. The patient is now able to walk well, the knee is nearly straight, and its movements are quite free; but sensation in the foot is rather dulled, and he is unable to wear a strong boot, as the heel is still somewhat tender from the old pressure-sore. [*Ref. No.* 73.]

Case 2.—Rifleman A. W. was wounded Oct. 18, 1914, and was admitted on Oct. 21 suffering from a shrapnel wound on the inner side of the left knee. The wound was about the size of a sixpence, and was suppurating freely; a piece of shrapnel had been removed in France.

The limb up to the knee was very swollen and œdematous; the calf was extremely tense and painful, and could be seen to pulsate, with expansile pulsation. No pulse could be felt in the posterior tibial artery at the ankle, nor in the dorsalis pedis. The foot and toes were quite warm. As there was no urgency I decided to wait if possible until the wound had healed, which it did in three weeks.

Operation, Nov. 18, 1914.—Patient was anæsthetized, and a tourniquet applied. An incision about three inches long was made behind the inner side of the tibia, exposing a mass of clot and liquid blood. When this clot was sponged away a wound was found in the lower part of the popliteal artery, which lay exposed in the depths of the wound. The artery was almost completely severed, just above its division into anterior and posterior tibials.

A stout catgut ligature was tied above and below the wound in the artery, a small drainage tube inserted, and the skin wound sutured. The swelling and œdema rapidly subsided, and the wound, after discharging serum and pus for a time, healed completely in three weeks.

Owing to the swelling and tenderness of the limb prior to operation the leg had been placed on a pillow, and had become stiff and flexed at the knee; so when the wound had healed, gas was administered and adhesions were broken down. As a result the patient developed an acute synovitis of the knee, and after a couple of days it was obvious that acute suppurative arthritis was beginning. Accordingly the joint was opened, a quantity of purulent fluid evacuated, and the joint drained. The inflammation gradually subsided; but it has left him with only slight range of movement, in spite of attempts to move the joint on two subsequent occasions under anæsthetics. Although the foot and toes were always warm and the circulation appeared good, a small ulcer appeared on the sole of the foot which was very resistant to treatment; but it eventually healed. [*Ref. No.* 74.]

Case 3.—**Varicose Aneurysm of the Femoral Artery in Hunter's Canal.** (Under the care of LIEUT.-COL. SOUTHAM, R.A.M.C.(T.)

Private E. P., age 26, was wounded in France, April 24, a rifle bullet passing through the inner side of the left thigh, about its middle. On May 8 he was admitted into the High Street branch of the hospital, presenting well-marked signs of an arterio-venous aneurysm of the femoral artery in Hunter's canal, which had been first noticed a few days previously; the wounds of entrance and exit were soundly healed.

There was a swelling on the inner aspect and front of the thigh which distinctly pulsated, each beat being accompanied by a marked thrill and an audible whizzing sound. No pulsation could be detected in the popliteal or tibial arteries. Rest in bed and elastic pressure were not followed by any improvement, and an operation was performed on June 18.

On exploring the swelling by an incision over Hunter's canal, a well-defined aneurysmal sac, about the size of a cherry, which showed expansile pulsation, was found lying directly over the femoral artery and vein, and overlapping both vessels, which were firmly adherent to one another. Catgut ligatures were placed round the artery about two inches above and the same distance below the aneurysmal sac. Nothing further was done, the sac and the femoral vein, which was considerably dilated above and below the point of communication, not being interfered with, and the wound was closed.

The patient made a good recovery, and was up in the ward at the end of four weeks. He left the hospital for a convalescent home on July 26; the limb was daily becoming stronger, and he could walk without assistance. The pulsatile swelling and other symptoms caused by the aneurysm had disappeared. No pulsation was evident in the popliteal or tibial arteries, but the condition of the limb was in every way satisfactory. [*Ref. No.* 75.]

Case 4.—**Arterio-venous Aneurysm of the Brachial Artery.** (Under the care of LIEUT.-COL. SOUTHAM, R.A.M.C.(T.)

Private D. S. was wounded in action at the Dardanelles on May 20, a rifle bullet passing through the upper part of his left arm.

On July 1 he was admitted into the High Street branch of the hospital, a small swelling having been noticed a few days previously at the seat of the

injury. The wounds of entrance and exit were soundly healed. There was a well-marked pulsating swelling over the upper part of the brachial artery immediately below the axilla; at each beat a distinct thrill could be felt, accompanied by a loud rasping bruit. No pulsation was evident in the arteries at the wrist. As treatment by means of elastic pressure was not followed by any improvement, an operation was performed on July 12.

The swelling was exposed by an incision in the course of the lower part of the axillary and upper part of the brachial artery. No aneurysmal sac was present as in the previous case, but the brachial vein, which was intimately adherent to the artery at the point of communication, was much dilated for some distance. A catgut ligature was passed round the axillary artery about two inches above the communication, and another round the brachial artery about the same distance below, and the wound was closed. The vein was not interfered with, and no attempt was made to secure the opening in the artery.

The wound healed rapidly without any complications, and he left the hospital for a convalescent home, July 27, with good use of the arm, all traces of the aneurysm having disappeared. No pulsation could be felt in the arteries at the wrist. [*Ref. No.* 76.]

Case 5.—**Arterio-venous Aneurysm of the Left Popliteal Vessels.** (Under the care of MAJOR A. H. BURGESS, R.A.M.C.(T.)

Private J. A., age 29, was admitted on Jan. 28, 1915. Some three weeks previously he had received, near Ypres, a rifle-bullet wound a little above and to the inner side of the centre of the left calf, and was under the impression that the bullet had been removed in France. A radiogram had been taken elsewhere soon after his arrival in this country, but with negative result (probably because an insufficient portion of the limb was radiographed), and he had been sent to one of our local Red-Cross hospitals. While there the region around the wound, which had healed quite primarily, became increasingly swollen, with evident pulsation. The increase in size had become very marked during the two days prior to his transference to my care at the Manchester Royal Infirmary, when the condition appeared rather alarming.

The popliteal space and upper half of the calf presented a firm swelling the size of a cocoanut, the entrance wound of the bullet being so tightly stretched that it had given way; a large piece of black blood-clot protruded, threatening a rupture of the aneurysmal sac. As no exit wound could be detected, the whole of the limb was searched with the fluorescent screen, and an unbroken rifle-bullet was disclosed lying against the back of the lower end of the femur, some seven inches higher up the limb than the entrance wound. Under anæsthesia, and with a tourniquet round the upper part of the thigh, the clot was removed from the entrance wound; a finger inserted led into a large cavity, filled by blood-clot and fluid blood, formed by separation of the cellular tissues between the gastrocnemius and the deeper muscles, and extending well up into the lower third of the thigh. An incision about six inches long was made in the middle line of the popliteal space, and the upper part of the sac laid freely open. The bullet was found embedded in the upper part of the posterior ligament of the knee, and on its removal some synovial

fluid escaped. The popliteal vessels were exposed, and about one inch above the division of the artery into its terminal branches it was found to be very closely adherent to the vein. On relaxing the tourniquet momentarily, blood escaped from an opening in the vein at this region, and on separating the vein from the artery a small oblique slit was found in the arterial wall. Feeling doubtful of the capabilities of the damaged vessel-wall to retain sutures, I ligatured both artery and vein above and below the wound, and closed the skin incision and the original wound of entrance without drainage. At the conclusion of the operation the toes were dusky, with very slow circulation; but by the following morning they had resumed their natural colour, and at no time was there any suggestion of gangrene. The wounds healed primarily, and the patient was able to walk about and leave for a convalescent hospital within one month. [*Ref. No.* 77.]

Case 6.—**Traumatic Aneurysm of the Right Radial Artery.** (Under the care of MAJOR A. H. BURGESS, R.A.M.C.(T.)

Private F. G., age 19, was admitted on July 26, 1915, having received a rifle-bullet wound of the right forearm in the Dardanelles on July 7. The bullet entered on the anterior aspect of the forearm just below the elbow, and escaped on the dorsal surface of the web between the thumb and forefinger, traversing almost the entire length of the forearm. The wounds were cleansed under anæsthesia in Gallipoli, and healed readily. Eight days later he first noticed a swelling on the anterior aspect of the forearm, which increased steadily until a few days before admission, since remaining stationary.

On admission there was a globular swelling, about an inch and a half in diameter, on the anterior aspect of the right forearm about its centre, visibly pulsatile, soft, readily emptied by compression, the pulsation being immediately arrested by compression of the brachial artery.

On July 30 the swelling was opened under anæsthesia, emptied of blood-clot, and found to communicate with the radial artery, which had been partially divided. The artery was ligatured above and below the aperture of communication. Healing readily occurred, and the radial pulse still remained at the wrist. [*Ref. No.* 78.]

Case 7.—**Aneurysmal Varix in the Left Popliteal Space.** (Under the care of MAJOR A. H. BURGESS, R.A.M.C.(T.)

S. G., age 26, a Russian—who, being in Belgium at the outbreak of the war, voluntarily enlisted in the Belgian army—was wounded near Namur by the bursting of a shrapnel shell, and after a short stay in a local hospital was transferred to the 2nd Western General on Oct. 20, 1914. He had sustained compound fractures of the right thigh and left forearm, and flesh wounds of the scalp and all four limbs. A small fragment of the casing had entered a little below the centre of the left popliteal space, and was easily felt subcutaneously on the outer and anterior aspect of the thigh, two inches above the upper edge of the patella. It was readily removed by incision.

Three weeks later the left leg was noticed to be slightly œdematous, the superficial veins of the calf were enlarged, and a swelling the size of a walnut

was then discovered in the popliteal space. It was soft, readily compressible, with a very well-marked systolic thrill, and with a bruit of the typical 'fly-in-a-paper-box' character. On account of his other injuries he was detained in hospital some four months, during the last month of which he was able to get about fairly actively. There was no increase in size of the popliteal swelling during this period, the physical signs of which became, if anything, slightly less marked; and as the condition caused him no inconvenience, he was averse from operative treatment, and left for a Red-Cross hospital wearing an elastic bandage. The condition appeared to be a typical aneurysmal varix. [*Ref. No.* 79.]

Case 8.—**Arterio-venous Aneurysm of the Left Popliteal Vessels.** (Under the care of MAJOR A. H. BURGESS, R.A.M.C.(T.)

Private C. J. D., age 20, was admitted on Aug. 31, 1915. He was wounded Aug. 13 in Gallipoli, a rifle bullet traversing his left popliteal space. The wounds healed very readily, and he suffered but little inconvenience until Aug. 24, when he noticed a throbbing pain at the back of the knee, which has since steadily increased. On admission, there were two small recent scars, that of the entrance wound being two inches from the outer side of the patella about the level of the joint, while that of the exit wound was one inch lower down and just to the outer side of the inner hamstrings. The lower part of the popliteal space was occupied by a prominent swelling, soft and compressible, and with obvious pulsation, immediately arrested by compression of the femoral artery. A well-marked systolic thrill and bruit were noted, but there was no obvious enlargement of the superficial veins. He complained of very severe pain in the knee, and held the joint quite rigidly.

On Sept. 2, under ether anæsthesia, and with a tourniquet round the thigh, an incision six inches long was made in the mid-line of the popliteal space. Under the inner head of the gastrocnemius a cavity was opened, about the size of a hen's egg, containing old dark blood-clot and some fluid blood. The popliteal vessels were closely adherent for a distance of two inches, and on separating them from each other and from the adjacent tissues, it was found that both vessels had been completely perforated, the apposed margins of the perforations in the superficial aspect of the artery and the deep aspect of the veins having become adherent, while the perforation on the superficial (or inner) aspect of the vein led into the aneurysmal sac; the blood passed, therefore, from the artery across the vein into the sac, the latter having no direct communication with the artery. The artery and vein were each ligatured above and below the perforation, and the skin wound closed completely. The circulation in the toes, on removal of the tourniquet, seemed quite active.

The progress of the case to the date of report (Sept. 7) is in every way satisfactory. [*Ref. No.* 80.]

Case 9.—**Varicose Aneurysm of the Left Common Carotid Artery and Internal Jugular Vein.** (Under the care of CAPT. E. D. TELFORD, R.A.M.C.(T.)

Private A. D., age 21, was admitted May 13, 1915. On May 9, at Ypres, he had been hit in the left side of the neck, just above the sternoclavicular

joint, by a fragment of shell. On admission, there was a diffuse swelling, about the size of a walnut, situated with its centre two inches above the inner end of the left clavicle. This swelling was covered by normal skin except at its summit, where a small, circular, septic ulcer marked the point of entry. Forcible expansile pulsation was evident, and everywhere over the swelling a harsh buzzing bruit could be both felt and heard. A radiogram disclosed a very small splinter of shell, deep in the neck to the left of the spine. The absence of any other symptoms was noteworthy; the patient was not in the least affected by the swelling, and in fact seemed unconscious of its existence.

It was decided to defer treatment until such time as the surface lesion was healed. The course of the case was without incident until June 7, when there occurred a very rapid increase in the size of the swelling. On the following day it had increased to the size of a billiard ball, with great pain and thrusting of the head towards the opposite shoulder. Pulsation and bruit were alike increased.

The ulcer having fortunately healed, an incision four inches in length was made over the summit of the tumour. Through this incision the lower end of the common carotid artery was isolated, and tied with two ligatures of No. 4 chromic iodine gut. The operation was difficult owing to the pulsation of the overhanging sac. The sac had a very thin wall, and was lying on the anterior surface of the common carotid artery and internal jugular vein. After ligature of the carotid the pulsation ceased, and there was marked diminution in the size of the swelling. Dissection was then carried cautiously upwards, when the thinned sac, adherent to the skin at the point of injury, suddenly gave way, with most profuse venous hæmorrhage. This having been arrested by pressure, the incision was carried up rapidly to the angle of the jaw, and the internal jugular vein was exposed above the sac. Temporary digital pressure over an aneurysm needle produced no appreciable slackening of the hæmorrhage, which it was now evident was derived from the lower end of the internal jugular vein.

The condition of the patient was by this time so grave that, in view of the difficulties which must have arisen in securing the dilated lower end of the jugular and controlling the hæmorrhage at the same time, it seemed better to attempt the closing of the rent in the sac. This was fortunately easily done with a continuous suture of fine gut, and proved quite effective. The wound was closed, and a firm bandage applied.

The after-history of the case was entirely without incident. No disturbance followed the ligature of the carotid. The patient left the hospital on July 14, with the wound healed. There was no sign of swelling or pulsation; the movements of the head were good; and he had recovered well from the great loss of blood. He writes on August 10 to say that, excepting for a slight stiffness of the neck, he is perfectly well. [*Ref. No.* 81.]

Case 10.—**Aneurysmal Varix in the Right Popliteal Space.** (Under the care of Capt. Chas. Roberts, R.A.M.C.(T.)

Private R. S., age 22, was wounded by a rifle bullet in France on May 22, 1915, at a range of about four hundred yards. The missile passed transversely

across the right popliteal space. The apertures of entrance and exit were both small. There was no swelling of the synovial cavity of the knee-joint and no fracture of bone. Considerable hæmorrhage occurred during the first twenty-four hours following the injury. The wound healed satisfactorily in a fortnight. A bruit was first noticed ten days after the infliction of the wound.

He was admitted to the Manchester Royal Infirmary on June 20. He complained of considerable pain and weakness in the leg. The knee was flexed through an angle of 30°, and he was unable to bear any weight on the limb. The usual signs of an aneurysmal varix of the popliteal vessels were present.

Operation, June 24.—A median vertical incision was made. Beneath it a broad transverse band of adhesions was found matting together the structures of the popliteal space. The adhesions were divided and the structures freed, and it was then seen that the popliteal artery communicated with the vein, and was firmly adherent to it for a distance of one and a half inches. The vein was much dilated above and below the point of communication. The artery was ligatured above and below this point, no attempt being made to separate the artery from the vein. A back splint was applied to keep the knee fully extended.

There was considerable pain during the week following the operation; but the circulation was very soon re-established, and the wound healed uneventfully. There was a marked tendency towards the formation of fresh adhesions, causing recurrence of the flexion of the knee. Massage and passive movements were employed, and when he was discharged, on Aug. 17, the knee could be fully extended; but there was still some loss of power in the limb. [*Ref. No.* 82.]

Case 11.—**Anterior Tibial Aneurysmal Varix.** (Under the care of Major J. Howson Ray, R.A.M.C.(T.)

2nd Lieut. W., age 23, was admitted to hospital Aug. 1, 1915, suffering from a pulsatile swelling in the upper fourth of the anterior tibial compartment of the right leg. On June 4 he was wounded by a rifle bullet which entered about two inches below the head of the fibula, emerged at the anterior border of the tibia slightly below this level, and was found lying under his puttee. This bullet had its point blunted and grooved, and its base was not quite circular, owing to a flattening of one side for about a quarter of an inch in the long axis. It would therefore appear probable that it was a ricochet, and that its force was almost spent before reaching the leg. There was very little bleeding, and the two wounds healed well in a fortnight.

It was not until about a month after the receipt of the wound that pulsation was noticed in the upper part of the leg, and for a time a bandage was applied; the pulsation diminished, and it seemed probable that a spontaneous cure was likely to occur. But further experience showed a recurrence of the pulsatile swelling, and after the patient's return to England and a more extended trial of bandaging, with rest, the swelling increased so much that he was admitted to hospital for operation.

On examination there was found a swelling about 3 inches by 2½ inches in the upper part of the right anterior tibial compartment. The swelling

was pulsatile, and had a purring thrill. The tibialis anticus and extensor longus digitorum were spread over the tumour, and an *x*-ray photograph revealed a small area of atrophy on the outer border of the tibia, corresponding with the centre of the swelling due to the aneurysmal varix. Compression of the femoral artery at the groin caused the swelling to subside in about two to three minutes.

There were practically no nerve symptoms of any moment. Rest in bed, with bandage applied to the leg, caused diminution of the tumour to about two-thirds of its former size within three days.

Operation was performed on August 6, Lieut. E. S. Brentnall giving the anæsthetic, and Capt. P. R. Wrigley assisting me in the operation. A tourniquet was applied in the upper part of the thigh, and an incision of 6 or 7 inches made on the front of the leg to expose the sac. The anterior tibial muscle was separated from the extensor longus digitorum, and the sac dissected right down to the interosseous membrane, care being taken to displace the anterior tibial nerve well outwards. The sac was well-formed and thick, and fairly easy to separate until one approached its origin, where it proved to be friable. The vessels were easy to identify below the level of the sac, and the artery was separated from the venæ comites and ligatured. Above the sac, however, it was very difficult to recognize the artery and veins, so the sac was opened, a little clot cleared out, and the lateral openings into the artery and vein were exposed. The opening into the artery was about a quarter of an inch long, that into the vein about three-eighths of an inch. A probe was passed into the arterial orifice and upwards to identify the artery above. Next an aneurysm needle was passed round the vessel marked out by the probe, and a ligature applied. To make the parts more secure the orifices of both artery and vein into the sac were closed by catgut carried on curved needles; after this the sac was obliterated by means of a mattress suture, and finally reinforced by infolding its walls and suturing these with catgut, so as to make a pad over the closed wounds in the vessels. On relaxing the tourniquet some rather free venous bleeding occurred from communicating vessels; this was dealt with by ligature, by an encircling suture of catgut carried so as to include veins and some muscle fibres, and finally by gauze packing, the greater part of the wound being sutured.

The gauze packing was removed in three days, and no further oozing of blood occurred. All sutures were removed by the tenth day, and healing was uneventful. The limb is now quite sound, the anterior tibial muscles have not been affected, and circulation in the limb is unimpaired. [*Ref. No.* 44.]

XI.—FOUR CASES FROM THE 3rd NORTHERN GENERAL HOSPITAL.

By Lieut.-Col. SINCLAIR WHITE, R.A.M.C.(T.).

Case 1.—Traumatic Aneurysm of the Axillary Artery.

Private J. H., age 18, was wounded at Ypres on Oct. 20, 1914. A small piece of shrapnel casing struck him below the outer third of the right clavicle and lodged at the back of the axilla. For the first few days he spat a little

blood. He was admitted to the hospital Nov. 10. The small wound was healed. Underneath it an expansile pulsating swelling could be felt. There was a loud bruit which could be traced along the axilla to the upper third of the arm. The right radial pulse was feeble, and showed a typical aneurysmal tracing when examined by the sphygmograph. Pressure on the third part of the subclavian arrested the pulsation. He was kept under observation for fourteen days, during which the swelling steadily enlarged, and he began to have tingling and numbness of the fingers.

On Nov. 25 the third part of the right subclavian artery was ligatured in continuity by a double strand of twisted silk. The wound healed aseptically, and a month later all traces of the aneurysm had disappeared, and there was no disability of the limb. [*Ref. No.* 83.]

Case 2.—**Aneurysm of the Axillary Artery.**

Private D. M., age 23, received a bullet wound below the outer third of the right clavicle on Oct. 14, 1914. The bullet, after traversing the chest, escaped below the left scapula. He was admitted to the hospital on Oct. 25. The wounds were healed, and the patient expressed himself as feeling quite all right. Just under the wound of entry a well-defined pulsating and expansile swelling could be made out. There was a marked thrill to be felt over it, and a loud bruit which could be heard in the axilla. The right radial pulse was diminished and somewhat delayed. A sphygmographic tracing showed a slight percussion wave and practically no dicrotism. Pressure over the subclavian artery arrested the pulsation. The right pleural cavity was distended with blood.

He was kept under observation until Dec. 3. During this period the swelling increased very considerably in size, and the pulsation became more forcible. The hæmothorax, on the other hand, showed evidence of being slowly absorbed.

On Dec. 4, a temporary ligature of fine rubber tubing was placed around the third part of the right subclavian artery, and the aneurysm was exposed by separating the fibres of the pectoralis major muscle. It was globular in outline, and of the size of a Victoria plum. On laying it open a fierce gush of blood escaped from the distal end of the axillary artery, also from what appeared to be the external mammary artery. Both these were ligatured, and the temporary ligature on the subclavian was replaced by one of silk. The wound healed aseptically, and he had no further trouble. He was discharged as convalescent on Jan. 4, 1915.

It was hoped to treat this case by Matas' method, but the furious bleeding from the distal and anastomotic arteries rendered such a procedure impossible. [*Ref. No.* 84.]

Case 3.—**Bullet Wound of the Profunda Femoris Artery.**

Private F. W., age 21, was wounded in the right thigh at Ypres on May 31. A rifle bullet went clean through the limb, and there was profuse primary hæmorrhage. After being treated for ten days on expectant lines in France, he was sent home and admitted to the hospital on June 12.

He presented two small circular wounds at the junction of the upper and middle thirds of the thigh, one in front and the other behind. They looked quite healthy, and were nearly healed. He complained of severe cramp-like pain in the thigh and down the leg. The thigh was obviously swollen, and at the level of the wounds its circumference measured two inches more than that of the sound limb at the same level. Palpation revealed considerable tension and a definite pulsation. Auscultation elicited a moderately loud bruit, which could not be detected lower than the middle of the thigh. A sphygmographic tracing of the anterior tibial artery showed nothing abnormal. The pulsation and bruit both ceased when the external iliac artery was compressed.

The patient was watched for four days, during which the swelling and pain increased considerably, and morphia had to be given to secure sleep.

On June 17 the common femoral artery was exposed, just below Poupart's ligament, and surrounded with a temporary ligature of fine rubber tubing. The incision was then prolonged downwards, and the swelling carefully explored. The superficial femoral artery could be traced downwards in front of it, and was clearly not implicated. After dividing a thick layer of muscle, a large irregular-shaped cavity full of blood-clot was entered. On removing the blood-clot there was some oozing, but no spurting of blood. The interior of the cavity was illuminated by the aid of a forehead electric lamp while an assistant slowly relaxed the temporary ligature. Furious bleeding from a wounded vessel at the back of the cavity could be seen; it was judged to be from the trunk of the deep femoral artery, but the tissues were so infiltrated with blood that it was impossible to see clearly. After much difficulty ligatures were placed above and below the bleeding site. These, while they controlled the greater part of the hæmorrhage, did not arrest it altogether. Complete hæmostasis was finally secured by applying four pairs of artery compression forceps to bleeding points; these were removed at the end of forty-eight hours. The patient made an excellent recovery, and the wound healed without visible sepsis. [*Ref. No.* 85.]

Case 4.—**Aneurysmal Varix in the Region of the Femoral Vessels.** (Under the care of Capt. Thos. B. Mouat, R.A.M.C.(T.)

Private W. W. On Oct. 19 the patient was wounded with fragments of shrapnel casing, in both thighs and the right shoulder. The wounds were sustained about 11 a.m., and apparently bled freely after the temporary dressings were applied, as patient lost consciousness for some time, but noticed that he was lying in a pool of blood when he was removed from the trench at about 7 p.m. Ever since his recovery from the initial shock of the injury, the patient has been conscious of a curious tingling thrill at the site of the wound in the anterior aspect of the upper portion of the left thigh; and on applying the hand to the dressings over this wound, a continuous thrill, increasing with systole, is felt.

On examination, a small and nearly healed wound was found present in the upper portion of the left Scarpa's triangle, over the femoral vessels. There was no swelling of the tissues at the site of the injury, and the impulse of the

femoral artery seemed normal in the portions of the artery distal to the wound ; but on applying the hand to the thigh in the region of the wound, a striking, continuous, vibrating thrill was felt and heard, over and for some distance down the limb, in the line of the vessels. The sound on auscultation was startlingly loud, and resembled somewhat the rhythmic clang of the engines of a steamboat. This bruit was so loud that a satisfactory phonographic record was obtained by applying the chest-piece of a binaural stethoscope to the affected area. A skiagram showed a small fragment of shrapnel lying about half an inch deep to the femoral vessels.

Varicosity of the veins of the affected limb was slight, and late in making its appearance, only becoming apparent some eight weeks after admission, when patient had been getting about for some time.

The patient was kept under observation for several months. Except for the slight enlargement of the superficial veins, the condition remained stationary; and as there was no discomfort or disability, it was decided not to operate. [*Ref. No.* 86.]

NOTES ON SURGICAL DISEASES OF THE COLON, BASED UPON A DEMONSTRATION GIVEN IN THE ROYAL VICTORIA INFIRMARY, NEWCASTLE.

By RUTHERFORD MORISON, Newcastle-upon-Tyne.

RARE CAUSES OF CHRONIC INTUSSUSCEPTION.

Three specimens, removed by operation from elderly men in the last six months, were exhibited.

Remarks.—Surgical opinion is agreed in believing that chronic intussusception in adults is the result of tumour growth, and in elderly adults it is so likely to be due to a malignant tumour that, until the contrary is proved, one ought to expect this as the cause. These specimens show that this rule cannot be applied with absolute confidence, so that they are of highly practical interest. The first specimen shows a polypus the size of a medium-sized pear hanging from the interior of the descending colon. It is a pedunculated, submucous lipoma. At the time of the operation there was an active, superimposed on a chronic, intestinal obstruction. An alternately hardening and relaxing tumour in the left iliac fossa with signs of obstruction made a diagnosis of chronic intussusception easy. The abdomen was opened by an oblique left lateral incision over the tumour, which was found to be caused by an irreducible intussusception of the descending into the iliac colon. Acting upon the probability that this was due to a malignant growth in the colon, a wide excision of bowel and mesentery was made. The distal extremity of the iliac colon was closed and returned to the abdomen. The proximal opening at the splenic end of the transverse colon was mobilized, brought out through the incision, drained by a Paul's tube, and fixed by sutures to the abdominal wall. Part of the iliac colon, all of the descending colon, the splenic flexure, and a corresponding area of the mesentery were excised. When the patient had been given sufficient time to recover, his abdomen was opened, and, after closure of the artificial anus, the lumen of the intestine was restored by a lateral anastomosis (as in *Fig.* 111) between the transverse and iliac colon.

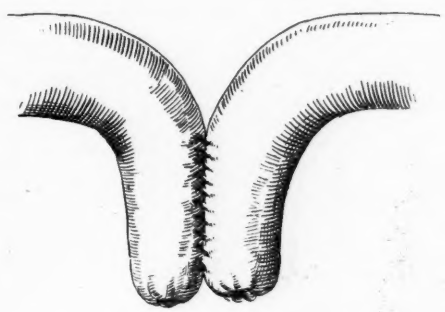


Fig. 111.—Lateral anastomosis.

The next two specimens are of even greater interest, because the mistake was made, after examining the bowel through the wound, of believing that a growth was present when there was none at all.

The second occurred one month after the first, and though I had the advantage of such a recent experience, with its valuable lesson, and did my

best to avoid another mistake, I could do no better than with the first. Both patients had symptoms and signs typical of chronic intussusception in the ileo-cæcal neighbourhood. The intussusception in both cases was easily reduced after the abdomen was opened. On reduction, such a definite, firm lump was felt in the head of the cæcum in both cases, that in the first I had no doubt a malignant growth was present there, and in the second my uncertainty compelled me to act as if there was. In both I tied the ileocolic artery, removing six inches of the end of the ileum, the cæcum, the ascending colon, part of the transverse colon, and the corresponding mesentery (Jamieson and Dobson's operation), and restored the intestinal lumen by lateral anastomosis between the ileum and the transverse colon.

Examination of both specimens shows that the lump which felt and looked macroscopically more like a carcinoma than anything else, was just a large localized swelling of the end of the cæcum, produced by hæmorrhage and inflammatory effusion, the microscope corroborating this. In both ileocæcal cases there was a congenitally defective attachment of the cæcum and colon, which still retained a long mesentery, and it seems probable that excision was the only promising means of preventing the recurrence of trouble. The operations performed, however, were much too serious if the condition could have been recognized. Excision of this portion of the colon in competent hands is no more dangerous than appendicectomy ; but the risk is considerably increased when a corresponding removal of the mesentery has to be undertaken at the same time. Though all these patients recovered, it is regrettable that such extensive operations seemed to be necessary.

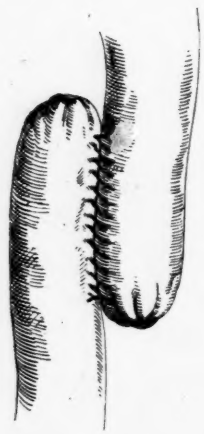


FIG. 112.—Lateral anastomosis between the transvers and iliac colon.

NOTE.—Dr. William Mayo, of Rochester, America, who was present, said that, in his opinion, the probability of malignant growth in these cases would not allow of more limited operation, and that it was at present impossible to distinguish such conditions from malignant growths during the operation.

CASES AFTER PARTIAL EXCISION OF THE COLON FOR CANCER.

Case 1.—A man, age 62. For not less than twenty years he had had chronic superficial glossitis, and a similar condition affected his cheeks and palate. From time to time I had treated him for ulcers on the diseased surfaces, and my confident anticipation was that cancer would sooner or later develop on one of these patches.

In February, 1909, he was admitted to the Royal Victoria Infirmary with acute intestinal obstruction after a long spell of chronic obstruction and constipation ; and on Feb. 16 I made a cæcostomy. On March 13, 1909, I removed a growth in his splenic flexure, with half of the transverse and descending colon, and made an anastomosis (*Fig.* 112) between the transverse and the iliac colon. There were large infiltrated glands in the mesentery close to the growth.

On March 27, fourteen days after the colon excision, I closed the cæcostomy ; and during the last four and a half years, so far as his abdomen is concerned, he has been quite well.

In May, 1912, however, he returned with cancer of his cheek, and this growth,

along with the neck lymphatics and the glands on the same side, was excised by a block dissection. The extensive scars show the extent of the operation. He is at present quite well.

The special interest in his case is that he has had cancer in two situations —a rare event. Microscopically, the mouth cancer was of an ordinary squamous type and the bowel growth of the usual columnar-celled variety.

Case 2.—A man, age 38. On Aug. 13, 1913, I excised fourteen inches of his pelvic colon and the corresponding mesentery, with many involved glands. The excision extended so far down in his pelvis that I could not make a lateral, and therefore had to perform an end-to-end, anastomosis (*Fig.* 113).

Many years ago I advocated this plan in cases of pylorectomy, pointing out the advantages of increasing the lumen at the anastomosis and diminishing the risk of an inefficient blood-supply, and I had used it with satisfaction in the small intestine, but never in the large bowel till Dr. W. Mayo told me he had found it most satisfactory there. In the drawing, the sharp corners of the longitudinal slit have been left. Before performing the anastomosis they should be rounded off.

In the following case, the patient, a woman, was operated upon in private seventeen years ago; she has refused to come for exhibition, and consequently I am only able to show the growth removed and to read the notes of her case, for which I am indebted to Mr. Hamilton Drummond.

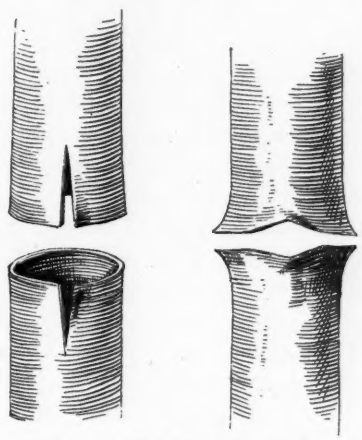


FIG. 113.—End-to-end anastomosis made after longitudinal splitting on the anti-mesenteric side of the bowel. The sharp angles are rounded off with scissors.

Case 3.—Mrs. G., age 45, was admitted into a private hospital in 1898 with the history that one year before she began to pass blood and slime in her stools. She appeared to be in good health, and nothing abnormal was made out on abdominal examination. By the rectum the bowel was found empty and ballooned; but a mass was palpable both by this route and per vaginam lying in Douglas's pouch and distinct from the uterus.

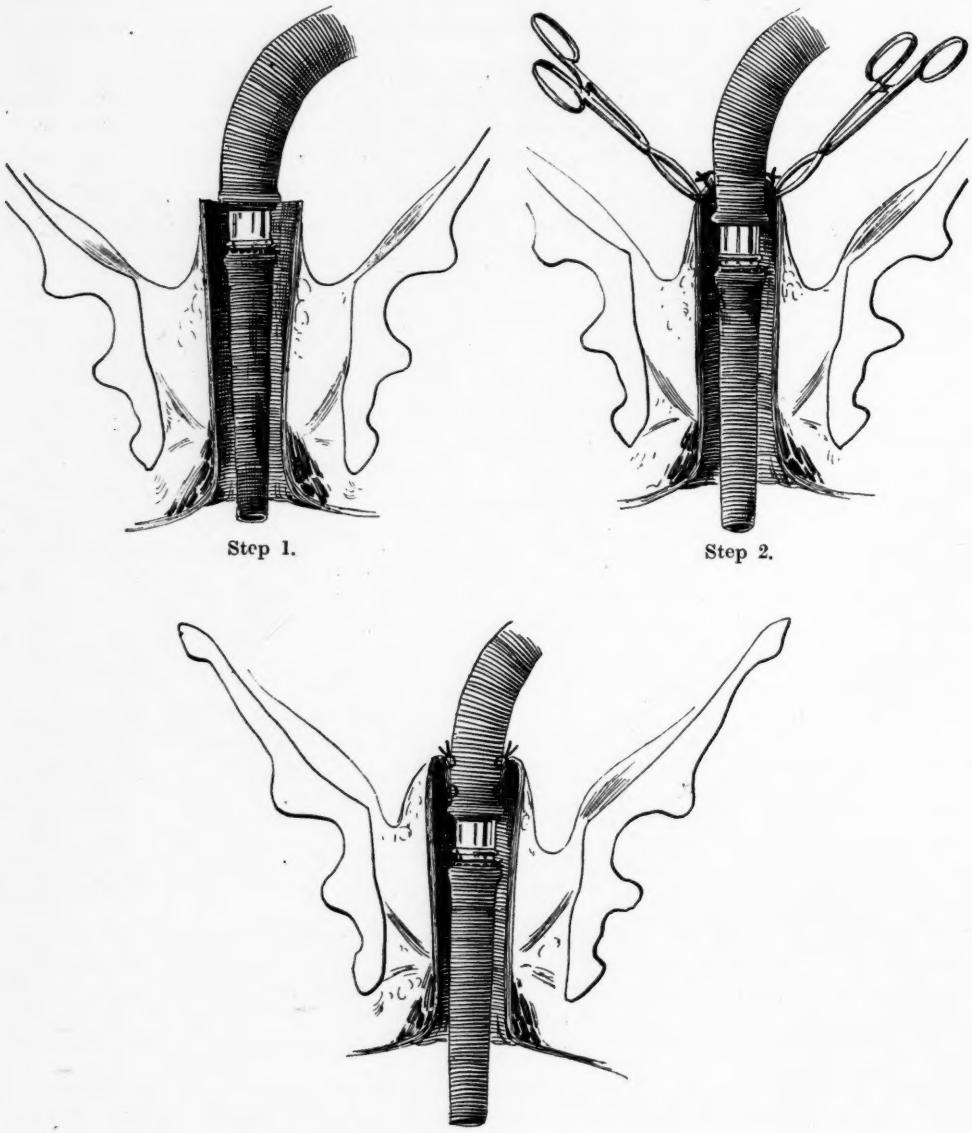
On Nov. 30, 1898, the abdomen was opened by a median incision. The patient was placed in the Trendelenburg posture and eight inches of the pelvic colon and upper rectum, with the corresponding mesentery, were excised. A glass bobbin with indiarubber tube was tied into the lower cut end of the pelvic colon and drawn through the rectum out of the anus, the anastomosis being completed with Lembert's sutures. (*Fig.* 114.)

The growth was of the mushroom type, $1\frac{1}{2} \times 2\frac{1}{2}$ in. in diameter. It was raised half an inch above the surface, and did not completely surround the bowel. Microscopical examination showed it to be a columnar-celled carcinoma.

Dr. Durant, of Gateshead, her medical attendant, writes to say that she is now in perfect health."

Case 4.—A man, age 59. On Sept. 2, 1913, I excised his colon and the corresponding mesentery—from the splenic flexure above to the middle of the iliac colon below—for a constricting carcinoma of the lower end of the descending colon. After mobilizing the splenic flexure, I made a lateral anastomosis between the transverse colon above and the iliac colon below (*Fig.* 111).

These cases illustrate conditions following cancer of the colon at the present time; but only successful examples can be shown. It is not true to say that surgeons can yet boast of their results from colon excisions, for the



Step 1. Step 2.

Step 3.

FIG. 114.—Anastomosis low down in the pelvis.

mortality is still very high—indeed so high that there are no long lists of successful operations, as there would have been if opportunities had presented themselves for boasting. My own results have been bad, for it took many

years to teach me what I now think I know, and the mortality, especially from the earlier attempts at excision during the stage of acute obstruction, was terrible. The first lesson we thought we had learned was that no large operation should be attempted in these cases, and the three-stage operation of (1) *Cœcostomy*, (2) *Excision of the growth*, and (3) *Closure of the cœcostomy* became the established routine. This plan has recently been challenged by Sir Arbuthnot Lane, who says the whole colon should be removed in these cases, and any suggestion of his surely demands most careful consideration. It specially appeals to me because I am satisfied that the new principle of removing a large area of the distended, sodden intestine and its septic contents above an acute obstruction in the small intestine—a principle for which we are indebted to Professor A. E. Barker—has not received the recognition it deserves. In my own experience (see paper in *Lancet*, 1910) as in his, it has proved to be a life-saving measure. Why should not the same principle be applicable to these cases? So strong was my belief in this possibility that four years ago, with the courage of conviction, in the case of a middle-aged man with obstruction due to a malignant stricture in the sigmoid flexure, I excised the enormously distended colon. Though his abdomen was much distended, solely by the enlarged colon, his general condition was good, and I decided on the ground mentioned to excise the colon. All went well till the middle of the transverse colon was reached, and there the tension caused a leak, difficult to block. During the further course of the operation this happened at several other places, and at each some contamination of the peritoneum was inevitable, with the result that the patient, though apparently well immediately after the operation, died of peritonitis. On opening the distended colon it was found to be leaking at the position of ulcers, some of which had nearly perforated. With this unfortunate experience in mind as a guide to some modification in technique, I would still venture in selected cases on excision of the distended colon and immediate anastomosis of the ileum to the portion remaining. This perhaps is one of the directions in which we may hope for further improved results, but more must be expected from earlier diagnosis, and the means by which this may be made are of first-rate importance.

A patient of middle age, who is complaining of constipation and increasing difficulty in securing a normal evacuation, with perhaps occasional diarrhœa and bloody discharge, should be regarded with suspicion. If there be attacks of pain accompanied by wind rumblings, and visible, palpable, or audible evidence of increased peristalsis, the probabilities of a malignant stricture of the colon are very great. If the cæcum becomes visibly distended during the attacks of pain, this is almost certainly due to a block in the colon below. What is to be done? First a rectal, then a sigmoidoscopic, examination should be made to confirm or exclude the presence of a growth within reach of the finger or the instrument. These methods have now almost received due recognition. An even more useful method, the opaque enema and *x*-ray examination, has not yet attained to the position its merits deserve. An *x*-ray examination, made after the administration of an opaque enema, can show that a stricture is present, and can give its exact position. The rule now is that patients are sent to the surgeon only when they have developed obstruction, and until this

is altered much improvement in the results cannot be expected, three serious operations still being rendered necessary. Thus the most important advancement in the treatment of these cases depends chiefly upon the skill in diagnosis of the practitioners and physicians who see them first. It is now generally accepted surgical knowledge that immediately successful operations for cancer of the colon, when performed on the well-known principles of wide excision of the growth and the lymphatic area into which it drains, are followed by a larger number of permanent recoveries than are operations for the majority of cancers. Jamieson and Dobson have described in detail the lymphatics of the colon, and have suggested what portion of the intestine should be removed to make a complete operation. It remains for surgeons who operate upon these cases to make themselves masters of a satisfactory technique.

The dangers common to all these operations arise from *shock*, *hæmorrhage* and *sepsis*.

Shock is quickly produced and soon becomes profound when distended, tense intestines are roughly manipulated and exposed. Physiological difficulties, which have not yet received the recognition they deserve, may make serious addition to it. For example, removal of the splenic flexure of the colon in a cobby, stout, muscular patient who continues obstinately rigid under the anæsthetic is an entirely different undertaking from the same operation on a lax, thin, flabby individual satisfactorily anæsthetized.

Hæmorrhage is a special danger, because mass ligatures of invisible vessels surrounded by a fatty envelope are often necessary. The risk can only be averted either by systematic dissection and ligature of the main supply trunk, or by careful ligature in small separate bundles of each portion of mesentery. A half-inch stump should be left beyond the ligature to prevent slipping.

Sepsis is the greatest danger of all, for post-mortem examinations prove that the majority of cases have died of septic peritonitis.

A few surgeons have already learned how these difficulties and dangers may be averted, and have proved that excision of the colon can be done as safely as appendicectomy. It is the duty of all who undertake these operations to learn their methods.

In obstruction cases the first operation has often to be limited to relief of the obstruction. In a paper of mine on intestinal obstruction published in the *Edinburgh Medical Journals* of July and August, 1904, I advocate drainage by cæcostomy, stating that, " The pressure of the intestinal contents is greater in the cæcum than elsewhere, and consequently, patchy gangrene of it may occur, wherever the obstruction in the colon may be. The cæcum is sufficiently movable to be drawn forward with ease, and a cæcostomy opening in the right iliac fossa is well out of the way of subsequent incisions, hence the choice of this part of the colon."

This simple operation in cases seriously ill can be performed under local anæsthesia ; but many patients with obstruction in the colon are well enough to allow of median-line exploration under a general anæsthetic, and unless the abdomen is tense or much distended this ought to be done. If the exploration shows that an inoperable growth is present, a permanent colostomy in the most suitable position can be made at once, further useless operation being avoided. During the exploration it is also possible to localize the growth as a guide to

future action, and to ascertain the presence or absence of secondary deposits in the peritoneum, glands, or liver before making a cæcostomy.

After excision of the growth an anastomosis is made as in *Figs.* 111, 112, 113, and 114. About two weeks later the cæcostomy opening is closed by an easy and safe operation.

MULTIPLE PAPILLOMATA OF THE RECTUM AND PELVIC COLON.

Case.—A boy, age 13. In Aug., 1908, a large rectal polypus was excised. His symptoms—diarrhœa, bleeding and prolapse during defæcation—quickly recurred. With the sigmoidoscope (Hamilton Drummond) numerous sessile papillomata could be seen occupying the interior of the visible bowel.

My house surgeon, Mr. Saint, reminded me that I had told him of multiple papillomata of the larynx cured by the rest following tracheotomy, and acting on his suggestion I opened the boy's abdomen on April 19, 1910.

Exploration showed that the growths did not extend higher than the lower portion of the iliac colon, and I did a left inguinal colostomy above the diseased part of the bowel.

After the operation all fæces passed through the artificial anus, and twice daily the patient's mother washed out his lower bowel from above and from below with sterile salt solution. By a second operation, performed on Oct. 24, 1911, eighteen months after the first one, the colostomy opening was closed. Before this was done repeated sigmoidoscopic examination showed no signs of growth.

The boy has not had any trouble since; there is no sign of recurrence; and he is, as you see, in excellent health years after closure of the colostomy opening.

A SPECIMEN OF IDIOPATHIC DILATATION OF THE COLON.

This was removed from a fair, thin, delicate-looking girl, age 16, who was admitted to Dr. Drummond's wards for intestinal obstruction. The history was one of indefinite life-long bowel trouble without serious pain until thirteen weeks before admission. Since then she had been troubled with serious abdominal pains coming on at frequent intervals, accompanied by loud wind rumblings. On admission, her abdomen was enormously distended and prominent in the centre. Forcible peristalsis of the oblique ladder pattern was pronounced, and she was obviously seriously ill. The diagnosis I offered was acute obstruction of the *small* intestine due to tuberculous stricture near the end of it.

On opening her abdomen (May 3, 1913) the enormous sigmoid protruded into the wound, and it was then discovered that the abdominal swelling was due to enlargement of the whole colon (*Fig.* 115). The small intestine was not distended. The diameter of the ascending colon was estimated by the registrar to be five inches. The end of the ileum was cut across and the whole colon was resected. An anastomosis was then made between the rectum and the cut portion of the ileum, and a tube was passed through the anus into the rectum and ileum and left there, after Lane's method.

The operation itself was well borne; but her condition after it was never satisfactory, and she died ten days after, on May 13, with constant diarrhœa which nothing checked.

The case is an interesting one because careful physical examination did not guide us to a correct diagnosis. If the condition of the patient had allowed of delay it is probable that an opaque enema and *x*-ray examination would have made it perfectly clear.

The surgical treatment might perhaps be improved upon. It is possible that if, as soon as I had discovered the true condition, I had emptied the colon through a rectal tube—which would have been easy because of the extreme

dilatation of the whole colon—had done a cæcostomy, and had removed the colon later when the patient's health had improved, the result would have been different.

The pathological cause of this and the allied conditions in other hollow viscera is still disputed. In this case it was evident that any ordinary mechanical obstruction was not the cause. The whole colon from cæcum to anus was involved. My suggestion as regards all of them is that the cause is a neuromuscular one, and that the obstruction is due to incoordination.

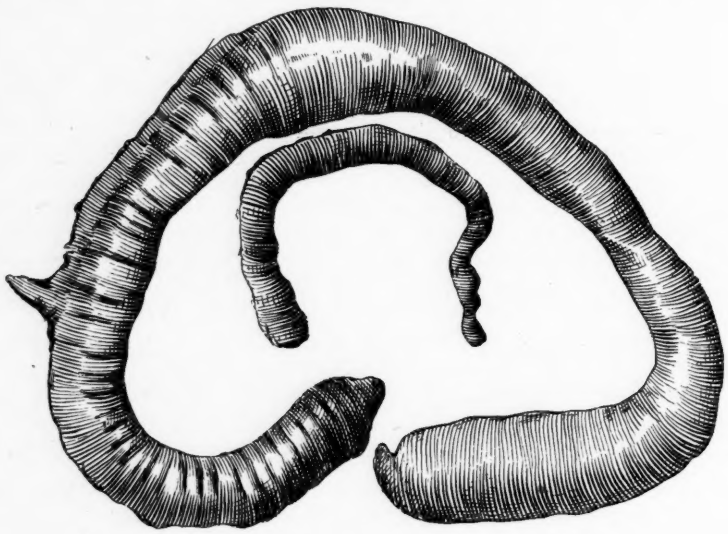


FIG. 115.—Shows the enormously enlarged colon.
The smaller inset figure is that of a normal colon, from a child of the same age.

A WARNING.

In a previously-mentioned paper (*Edinburgh Medical Journal*, 1904) the following sentence occurs :—

" More than once in obstruction situated between the cæcum and sigmoid I have seen the ileum united to the sigmoid flexure. The result has been distention, gangrene, and perforation of the cæcum, and death from peritonitis a few weeks after the operation. Though I have drawn attention before to the self-evident likelihood of this accident—self-evident if the usual competency of the ileocæcal valve to resist the escape of any of the cæcal contents backwards be remembered—it does not seem, judging by recorded cases, to have met with universal recognition."

Eleven years later I have learned that this method is actually *now* taught in some of our medical schools, and in a recent book, and is practised in the operative-surgery classes. Consequently, it is still necessary to tell what may happen when this operation is done ! If an obstruction exists in the colon, and an anastomosis is made between the ileum and the colon below the obstruction, the cæcum is likely to burst, and *must* do so if the obstruction is complete and the ileocæcal valve is competent. It will do so if the ileum is not divided,

because, however large an anastomotic opening be made, most of the intestinal contents pass the opening and follow their normal route. I learned this in early days when trying to cure fistulous openings in the cæcum by anastomosing the ileum and sigmoid. If the ileum were divided at the same time, the rupture would be delayed, but would eventually take place with no less certainty, from retention in the cæcum of its secretions.

The same principle that is violated in this operation, as illustrated by the case from which the first specimen (*Fig.* 116) was removed, is applicable in a larger field, as proved by the second specimen (*Fig.* 117).

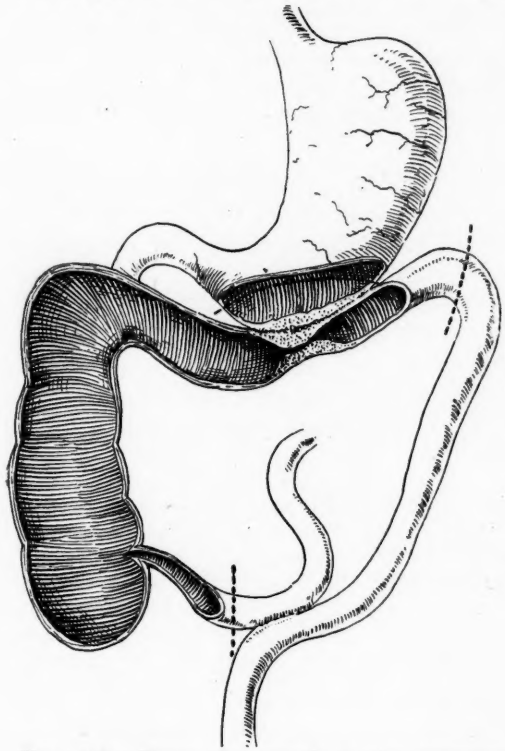


FIG. 116.—Shows the growth in the transverse colon and adherent to stomach. The portions excised are indicated by dotted line.

FIG. 117.—Shows the growth infiltrating the uterus and vagina.

The first operation in both cases was done by specially distinguished surgeons, not of this city.

The drawings were made by D'Oyly Grange, F.R.C.S., of St. Bartholomew's Hospital, London, from the specimens.

Case 1.—A man, age 66, eight weeks before his admission to the Infirmary, was operated upon for chronic intestinal obstruction. His doctor told me he had learned that the operation showed the cause to be a malignant growth in the colon, which was considered irremovable. An anastomosis had been made and the growth was left alone. The doctor did not know where the anastomosis had been made, but the patient was now as bad as ever. When I saw the man it was obvious that his cæcum was enormously distended and contained a quantity of fluid. During examination his cæcum could be felt and seen to harden and contract, just as a uterus in labour would, and he groaned with pain. On succussion of the cæcum during relaxation

there was marked splashing. His wife told me that the night before he left home she "could get no rest for the noises made by her husband's inside."

My diagnosis was that the anastomosis had been made between his ileum and sigmoid, and this was confirmed by the operation on Sept. 13, 1913. A large malignant growth was found in the transverse colon. It was attached to and infiltrating the greater curvature of the stomach, and there were many large glands in the transverse mesocolon, but no secondary growths apparent in the liver or in the peritoneum, except in the neighbourhood of the growth. The lower eight inches of the ileum, the colon up to the splenic flexure, the whole of the transverse mesocolon and glands, and the lower portion of the stomach and omentum were excised (*Fig.* 116).

The day after the operation the patient was so well that he was able to read a newspaper, and he went home recovered on Oct. 4, 1913.

Dr. Longbotham reports on Aug. 12, 1915 (nearly two years after the operation): "He was quite well until recently. He has now got a big mass in his belly. I think there is no doubt it is in his liver; but he still gets about, and in fine weather goes out. He is undoubtedly weakening, and latterly from time to time has a little sickness, but his bowels act."

For many years in inoperable stricture of any part of the colon, I have, after drawing down the omentum, made an anastomosis over it between the cæcum and the sigmoid flexure, and so avoided the troubles that occurred in this case.

The specimen removed (*Fig.* 116) consists of the end of the ileum, the cæcum and appendix, and the ascending and transverse colon, to which a portion of the stomach is attached. The inner longitudinal band of the cæcum has been torn across by the intravisceral tension due to the enormous distention of its cavity by fœtid, fæcal contents. Beyond the growth the colon is small and its walls thin.

Case 2.—A very stout lady, age 62, had inguinal colostomy performed for chronic intestinal obstruction, due to highly-situated rectal cancer, which was said to be irremovable. The operation was done by dividing the sigmoid colon about its middle, closing the lower end, returning it to the abdomen, and bringing the upper end outside to form an artificial anus. For six months after the operation the patient was entirely relieved from all serious symptoms and, except for occasional discharge from the normal anus, had little trouble. At the end of this time she began to have pain associated with increasing anal discharge and hæmorrhage, which were relieved by washing out the bowel through a catheter and the use of morphia.

I was asked to see her because this treatment had now failed to relieve her, and found a large cancerous growth in the rectum, invading the posterior vaginal wall and fixed to the uterus, but apparently not immovable behind (*Fig.* 117). Above the growth the bowel was distended by putrid fluid, which discharged at intervals, giving her relief, but quickly re-accumulated. It was sufficiently obvious how this trouble had arisen. There was insufficient escape for the putrid rectal contents locked up by the growth below and the operative closure above. There were no signs of secondary deposits, the growth, though extensive, still appeared to be local, and my proposal to attempt to remove the rectum with the growth, along with the uterus and the upper vagina, was accepted.

The operation was done on Jan. 11, 1911, after division of the vaginal wall and perineum and removal of the coccyx.

Prof. Stuart Macdonald's report was—"Both portions of tissue (growth and gland surrounded by fat) show widespread infiltration with columnar-celled carcinoma."

Dr. Adam Wilson, whose patient she is, writes on Aug. 11, 1915 (more than four and a half years after the operation):—"Mrs —— expresses herself always as being 'perfectly well,' and so she is—eats well, sleeps well, and gets about her ordinary household and social duties with absolute comfort. So far there is no sign of any recurrence or secondary deposits, and but for the artificial anus she is 'perfectly well.'"

SHORT NOTES OF RARE OR OBSCURE CASES.

UNILATERAL RENAL HÆMORRHAGE DUE TO OBSTRUCTIVE CALCIFYING PAPILLITIS.

By CHARLES A. PANNETT, London.

Chronic inflammation of the pyramids of the kidney without similar changes in the cortex is a condition to which but few references by writers are to be found. As a cause of painless renal hæmorrhage it has not been recognized hitherto.

In April, 1913, an unmarried woman, age 29, whose previous history from a medical point of view was devoid of interest, came under the care of Dr. W. H. Willcox, in St. Mary's Hospital.

Three weeks before admission, whilst rising after stooping to pass under a barrier, she "felt something give way," and almost immediately passed bloody urine. Since that date she had passed blood at every act of micturition. She had got very weak, and had lost weight. There had been no pain, no frequency of micturition, and no cough.

On admission she was seen to be extremely anæmic, all the mucous membranes presenting marked pallidity. The routine physical examination was almost wholly negative in results. Neither kidney was palpable nor was there renal tenderness. The spleen was not felt. The lungs were healthy. There was a hæmic systolic murmur at the heart's apex. The pulse was 88, of low tension; the temperature normal. The urine passed was of a deep port-wine colour and contained clots; sp. gr. 1·010. Microscopically, the deposit contained blood-corpuscles only; there were no pus cells, no casts, and no crystals. No bacteria were found in a film made from the centrifuged urine. Cultures developed a few staphylococci, but these were regarded by the pathologist as probably a contamination. No shadows in the region of the urinary tract were revealed by *x*-ray examination.

Ten days rest in bed led to no amelioration of the symptoms; the anæmia only became still more pronounced.

The case was then transferred to the surgical wards and a cystoscopy performed. The bladder was normal, as were both ureteric orifices; but from the right opening blood poured forth in frequent jets. The efflux from the left ureter was clear, and occurred at longer intervals. A numerical comparison between the frequencies of ejection from the two sides could not be made, as owing to the rapid flow of blood into the examining medium, the time allowed for observation was short. The left ureter was catheterized. The urine thereby withdrawn was clear, contained no pus or crystals, a very

few red corpuscles (so commonly seen when a catheter is allowed to remain in the ureter for a considerable time) and 2·2 per cent of urea. Apparently it was functioning normally. No colour test was performed.

An exploration of the right kidney was decided upon, to be followed, if no external lesion was discovered, by a nephrectomy, as being the most rapid and bloodless operation. The exploration was accordingly done two days later. No abnormality of the renal pedicle was revealed, neither did palpation of the exposed normal-looking kidney point to any gross lesion. The organ was excised.

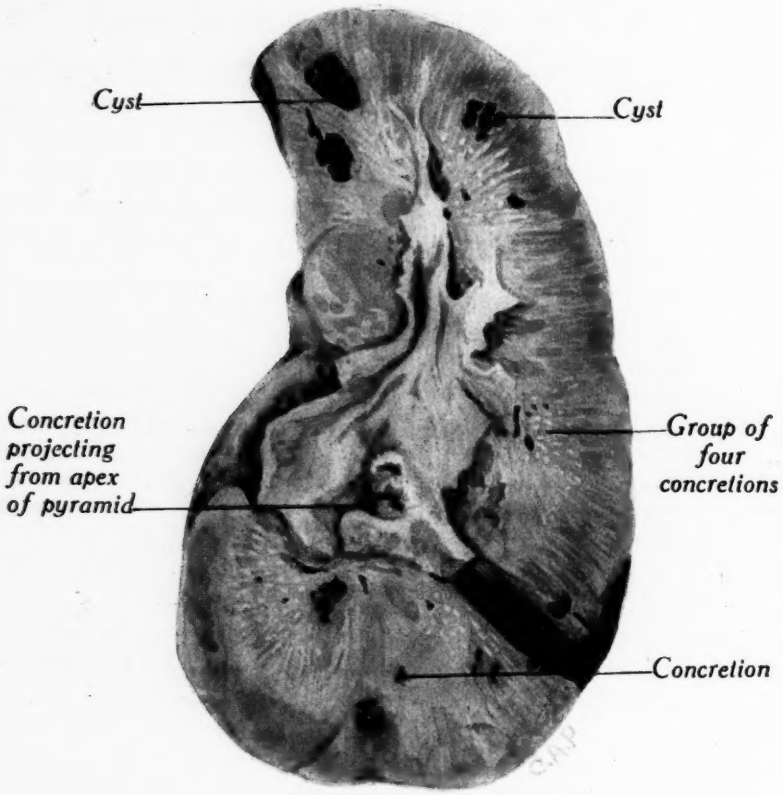


FIG. 118.—SECTION OF POSTERIOR HALF OF KIDNEY. Showing concretions, cysts, and stippled appearance of the pyramids. (*Five-sixths natural size.*)

After the operation there was no return of the hæmorrhage, and the patient made a good recovery. Seen nine months later she was perfectly well, but owing to the fact that she has since married, I have been unable to trace her to the present time.

Examination of the Removed Specimen.—Externally the kidney shows no abnormality. It is of average size—four and a half inches long. On bisecting the organ the cut surface (*Fig.* 118) shows radiating opaque stippling of the pyramids, which are firm and fibrous to the knife. Scattered through the pyramids, embedded in them, and here and there projecting from their apices into the pelvis, are minute seed-like calculi. These were white at

first, but gradually have turned to a dark brown colour. They are soluble in dilute hydrochloric acid with some effervescence. In the bases of the pyramids, and between them and the medulla, are numerous small smooth-lined cysts varying in size from a pin-head to a small cherry stone. There are no cysts in the cortex and none on the surface. The cortex is normal in appearance and the capsule strips easily. The pelvis and calices show no signs of inflammation or dilatation.

Microscopically, the most prominent feature is a large number of small areas of calcification in the pyramids (*Fig.* 119). The areas are mostly small and elongated, of the diameter of a collecting tubule, but in some places several have coalesced to form larger calcified masses which exhibit lamination. The calcified areas are surrounded by inflammatory irritative changes

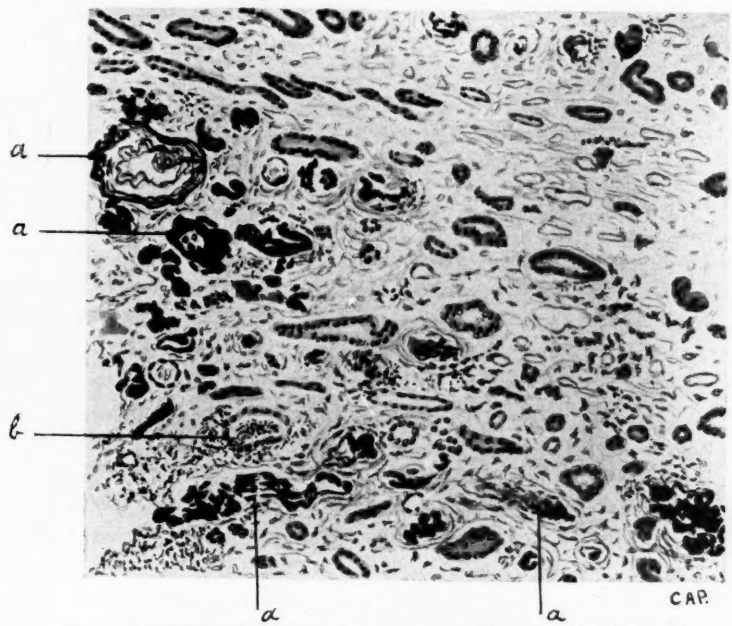


FIG. 119.—SECTION THROUGH MEDULLA.—Showing (*a*) calcified areas; (*b*) tubule, containing and surrounded by leucocytes. (× 82.)

in the neighbouring tissue, which has led to an intertubular sclerosis. Foreign-body giant cells are found near the calcified masses in many places.

Here and there are small areas infiltrated with leucocytes and round cells, and a few of the tubules contain numbers of leucocytes. The cysts have a thin connective-tissue wall and are lined by low flattened epithelium. The cortex presents no abnormal histological changes.

The pathology of this curious renal condition cannot be completely elucidated from the examination of a single specimen. That there was some primary lesion affecting the epithelium of the collecting tubules seems probable. All the stages cannot be seen in the sections of this case, but a careful examination suggests that there was first a necrosis of epithelium

(a kind of colloid degeneration), followed by calcification. The calcified areas then increased in size by deposition upon their surfaces. Obstruction of the tubule was produced, partly by this, and partly by the inflammatory changes in the surrounding interstitial tissue set up by the presence of the concretions. Hence dilatation of the tubules occurred above the obstruction, producing the cysts.

Nowhere do the appearances suggest calcium infarcts as the primary lesion.

No light at all could be thrown on the cause of the supposed original tubal necrosis, either from the history of the patient or the clinical and pathological examinations. A selective toxic action would seem to be the most likely explanation. Levaditi produced calcification and sclerosis of the pyramids in animals by giving them vinylamine. That the condition was apparently unilateral (though there is not absolute proof of this) does not altogether rule out this conception of the origin of the pathological process, for evidence seems to be accumulating in favour of the occasional existence of a unilateral toxic nephritis.

John Caulk[1] described a case in which one pyramid of a kidney had become sclerotic and encrusted with calcareous depositions, with the result that a large cyst developed at the base of the pyramid. The sclerosis extended to the cortex, and there was blood infiltrating the interstitial tissue, though hæmaturia was not a symptom of the condition. He regarded the case as one of primary necrosis and sclerosis of a pyramid, with secondary calcification.

Serous cysts, single or multiple, occur in the kidney, and are generally unilateral, but only rarely is hæmaturia a prominent symptom. Fowler[2] mentions this as occurring in one case, and Caulk refers to a case reported by Lipskeroff where there was profuse bleeding. But in neither of these cases is there mention of a sclerosis of the pyramids, the distinguishing feature in the case under discussion. Indeed the only specimen resembling it of which I can find a record is preserved in the St. Bartholomew's Hospital Museum, and by the courtesy of Dr. Andrewes I was able to examine it. The kidney was taken from a man, age 60, who died from carcinoma of the pancreas. It shows many cysts in the pyramids, of larger size than in my case, and scattered between them are minute dark calculi composed of calcium carbonate. The opposite kidney was healthy, and during life there were no urinary symptoms.

Of the propriety of nephrectomy in the case under discussion there can be no doubt. The loss of blood was so great as to endanger life. With less copious hæmaturia of shorter duration, it would of course be right to split the kidney longitudinally to search for such lesions as papillomata of the pelvis, varices at the apices of the pyramids, or a calculus fixed in a calix which had given no pain. Should no macroscopic lesion be found, the kidney should be sutured, after having removed small portions for microscopical examination; but should the association of numerous small cysts with a fibrous condition of the pyramids, the latter containing small embedded concretions, be found, nephrectomy is the right procedure.

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AN UNUSUAL CASE OF HYDATID DISEASE.

By SINCLAIR WHITE AND J. H. COBB, SHEFFIELD.

G. H., age 25, farmer, was admitted to the Royal Infirmary, Sheffield, on March 1, 1912. A few weeks previously he had been kicked in the abdomen by a cow. He says it was not a very severe kick, and after a few minutes he was able to resume his work. Some days afterwards he was troubled with abdominal pain, especially on exertion. About this time his abdomen began to swell; the swelling rapidly increased and he took to his bed. A day or two later his abdomen was tapped and eight quarts of greenish fluid were obtained. This gave temporary relief, but in a day or two the swelling was almost as marked as before, and he was sent into the Royal Infirmary.

The same day, March 1, laparotomy was performed. The peritoneal cavity contained a large quantity of bile-stained fluid, and a tear of the posterior surface of the liver was found. A drain was placed down to the tear, and the pelvis was drained by a Keith's tube placed through a separate opening above the pubes. He made a good recovery and was discharged on April 7.

He returned to work and remained well for some months; but he then began to be troubled with attacks of pain. These became more frequent and severe, and he occasionally had to take to bed. In the beginning of 1914 he noticed an enlargement of his abdomen, which steadily progressed until about June, when the enlargement was so great that he could no longer follow his occupation. He was re-admitted to the Royal Infirmary on February 17, 1915.

At this date the abdomen was greatly enlarged, the enlargement being most marked in the right hypochondrium. In this region several distinct cystic swellings could be felt. The whole surface of the abdomen was dull; there was no evidence of free fluid. A hydatid fremitus could not be obtained from any of the cystic swellings. Laparotomy was performed on Feb. 25, and the peritoneal cavity was found to be the seat of extensive hydatid disease. There were several large cysts attached to the liver and to the spleen; a mass of them occupied the omentum, and the pelvis was filled with them. Several of the cysts were removed. Since then he has had three other operations; each time cysts are cleared out of a selected part of the abdomen. The removal is still incomplete, but it is hoped in time to rid him completely of the cysts.

There can be little doubt that the present trouble dates from the kick he sustained in 1912. At the first operation a tear on the posterior surface of the liver was discovered, and was considered to be a rupture of the liver substance. Reviewing the case in the light of the subsequent history, it seems probable that the injury caused the rupture of a hydatid cyst of the liver. The hydatid fluid set free into the peritoneal cavity caused a peritonitis, with a free exudation of fluid. This he recovered from after being tapped and, later still, drained. Afterwards the contents of the ruptured cyst, scolices and brood-capsules, developed, and gave rise to widespread disease of the peritoneum.

REVIEWS AND NOTICES OF BOOKS.

Abdominal Injuries. (Oxford War Primers. Under the General Editorship of LIEUT.-COL. D'ARCY POWER, R.A.M.C.). By PROF. RUTHERFORD MORISON, F.R.C.S. With illustrations by LIEUT.-COL. W. G. RICHARDSON, R.A.M.C.,T. Small 8vo. London: Henry Frowde and Hodder & Stoughton. 2s. 6d. net.

THE subjects selected for these volumes are those which have an immediate relationship to the war, and the authors are chosen from among those whose civil and more recent military experience qualifies them to speak with authority. For the little work on *Abdominal Injuries*, the choice of Mr. Rutherford Morison as author is excellent. Mr. Morison is among the most distinguished representatives of abdominal surgery in the world to-day, and his teaching (not always perhaps quite orthodox) is based upon an experience of unusual range and variety, and of large bulk.

Mr. Morison affirms that there is not, and there never will be, any essential difference between the surgical principles which should guide civil and military surgeons, though the practice of the latter may not be the same as that of civil surgery, owing to the exigencies of military service. Military surgery, will, however, attain its greatest measure of success by following the lines which have been laid down by surgeons in their ordinary work the world over. It should be just as scrupulous, its ritual as exact, and its results in equal circumstances just as good, as in the work of civil life. A knowledge of the work in Flanders and in France during the last twelve months shows conclusively that it is only on the rarest occasions that military exigencies need serious consideration where questions of good surgical work and routine are concerned. Haste and slipshod work have no justification.

The book begins in academic fashion by discussing the diagnosis of injuries to the abdomen, and stress is very properly laid upon the need for a careful reading of the history, upon the recognition of physical signs, and upon the importance of an unceasing skilled watch for the developments in symptoms. It is satisfactory to note that palpation exceeds in value any other method of investigation of the abdomen: though the author himself hardly trusts it adequately, for he makes the surprising declaration that "a distended bladder which is neither visible nor palpable may reveal on percussion a rounded dull area in the hypogastrium." We had hoped that myths of this sort as to the value of percussion were all forgotten.

The frequency with which a rupture of the intestine occurs at the junction of a fixed with a movable portion is ascribed to "the driving of the bowel against a projecting bone surface"; the far more probable hypothesis of Radcliffe, who compares the laceration to the breaking of the string by a salesman—who wraps the cord round his finger and, on pulling, breaks the string as it leaves the fixed turn—is not mentioned. Muscular relaxation, and distention of the viscera at the time of the accident, are emphasized as important disposing causes of injury. When a wound of the parietes is inflicted, "the first rule to be made, and applicable in every case, is that wounds of the abdominal wall should be submitted to full exploratory operation," and "such an examination made of the wound as to make certain whether penetration has occurred or not,"—a surgical canon that might well be written up on the walls of every theatre in the clearing stations.

It is pointed out that 90 per cent of bullet wounds of the abdomen perforate one or more of the abdominal organs, and that in the case of the hollow viscera the rule is that both walls are involved. Forgetfulness of this rule has cost many lives.

Probably no surgical questions have excited more stubborn controversy during the war than those concerned with wounds of the skull and of the abdomen. Whether wounds of the skull should be dealt with by operation at once, or whether it is wiser to wait till the soldier reaches a base hospital; whether a mere cleansing of the wound of entry without a search for the bullet should be considered enough; whether, when a compound depressed fracture of the skull is present, a local trephining only should be advised, or whether a large flap should at once be turned down and a 'decompression' operation performed: these are all questions that have been gravely and fully discussed, and perhaps even yet there is no agreement between protagonists. So it is in the case of abdominal injury: it is wondered whether such cases should be left, treated 'expectantly,' or dealt with forthwith by operation; whether starvation, the 'Fowler' position, opium, and complacent inactivity give results over a series of cases to compare favourably with the practice of instant and invariable operation when the abdominal wall is pierced. Mr. Morison, we are glad to say, states the matter with perfect lucidity and confidence. He writes, "of serious abdominal injuries 20 per cent are hopeless, and of the remaining 80 per cent not less than 60 should recover if an early operation under satisfactory conditions can be performed." In the face of this belief, though it may in exceptional circumstances be wiser to limit treatment of bullet wounds to rest, the administration of opium, and abstention from food and drink, it is well to realize that, though expedient, it is not surgery.

The larger part of this work is devoted to technical considerations—descriptions of technique, and the details of operations upon the several viscera. Mr. Morison relies rather more on antiseptic methods than do many surgeons, but his counsel is wise when given to surgeons dealing with their cases in France, where so many other infected cases have also to be treated. The advice given and the practices authorized are excellent, with one exception only. There is a delightful reminiscence of the Murphy button and its use in intestinal surgery. But delight turns to dismay when we see this extraordinarily ingenious, if almost obsolete, instrument recommended for use in case of laceration of the gut at the duodenojejunal flexure. One half of the button is to be placed in the torn end of the duodenum, and the other half in the side of the jejunum (the torn end of which is closed by suture). What is to happen if the button drops back into the duodenum? It is just conceivable that there may be urgent military occasions in which the Murphy button might be found useful; but if there is one place where it may never be used, it is surely the duodenojejunal flexure.

The book is a very valuable addition to the literature of military surgery. It is well and concisely written, opinions are stated without reserve or misgiving, and almost every page indicates that the author has made most profitable use of a vast experience. All that Mr. Rutherford Morison writes is worthy the serious attention of every surgeon. He has probably never written anything of greater or more timely value than this little work. The illustrations by Lieut.-Col. W. G. Richardson are poor.

Injuries of Joints. (Oxford War Primers. Under the General Editorship of Lieut.-Col. D'Arcy Power, R.A.M.C.) By Robert Jones, F.R.C.S. Small 8vo. Pp. 186, with 29 illustrations and photographs. 1915. London: Henry Frowde and Hodder & Stoughton. 3s. 6d. net.

Under this simple title Mr. Jones has given us in compact form a book which covers a great deal of orthopædic surgery. He has confined himself chiefly to the aspects of joint injuries which are peculiarly his own province, and given us the benefit of his great personal experience to add to our general knowledge of the subject. The title is interpreted broadly, to include injuries near joints, such as fracture of the surgical neck of the humerus, Colles's fracture, etc.; and from the points of view of diagnosis and treatment there are good and obvious reasons why this should be so.

The first five chapters deal with general considerations. Certain principles are enunciated: (1) Accurate diagnosis. For example, it is not enough to say that the joint is sprained. One must locate the damage in the actual ligaments involved, so that treatment may be directed to immediate union by fixing the joint in the position which approximates the torn fibres; (2) Immobilization during the stages of repair. The process of repair in and around joints follows the usual physiological laws. Acute inflammation will become chronic if the injured tissues are subjected to mechanical irritation. The author emphasizes the importance of the scientific application of the bandage, not as a cover for a dressing but as a modified splint. Other weapons in his armoury are pads of sticking plaster, applied locally to promote absorption, and to tendons above the inflamed area to reduce muscular tension on injured attachments. Massage, as a thing apart from passive movements, is nearly always helpful at all stages, if of a suitable kind.

As regards movements, they are always bad for actively inflamed tissues. Involuntary reflex movements should be controlled by efficient fixation. Voluntary active movements which cause no pain can seldom be harmful, since the absence of pain shows an absence of irritation to injured parts. Passive movements should always have one definite aim—to force a free path for movements which are obstructed by adhesions. The process should be thorough, and carried out by one firm movement. Repeated to-and-fro movements are useless and dangerous. The advice on passive movements contains many warnings, and should be read carefully.

The later part of the work is devoted to regional injuries. In discussing those about the shoulder-joint, the author points out that the distorting cross-tension of the muscles can be neutralized only by fixing the arm in abduction beyond a right angle, in which position the pull in various directions is equalized. The same principle is to be applied to other joints.

As regards fractures about the elbow-joint: with the single exception of fracture of the olecranon, the position of full flexion is advised. This reduces callus formation to a minimum, since it leaves very little space in which callus may form. This is followed by gradual relaxation from the fully flexed position, according to the range of painless active movement. The importance of long fixation in flexion after reduction of simple dislocations is insisted on, owing to the dangers of local myositis ossificans, which strangely occurs oftener in such cases than in those with fracture. An excellent splint is shown for the treatment of compound and septic wounds of the elbow. The author's method of reducing Colles's fracture is well shown. For all wrist injuries below this level, dorsiflexion is good treatment.

Chapter VII deals with injuries of the back and spinal column. Stiffness following muscular injuries is treated in the same way as in other regions, by forcible stretching in flexion.

In the section on the lower limb, dislocation of the hip is thoroughly discussed in a simple manner. Modifications of Bigelow's method of reduction are advised, whereby less damage to soft parts is caused. In fractures about the upper end of the femur, as in those of the humerus, distorting muscle-pull is overcome by maintaining the position of abduction. The use of the author's abduction frame is illustrated. This frame is recommended for all compound fractures in this region. Fractures of the lower end of the femur may well be treated by extension in a Thomas knee-splint. Putting up in flexion is not necessary if muscular spasm is avoided by efficient fixation. The differential diagnosis and treatment of derangements of the knee-joint are carefully discussed.

In speaking of Pott's fracture, the author is not pessimistic as to final results. The sources of failure are twofold: incomplete reduction and inefficient after-treatment. After-treatment consists of complete rest for six weeks, followed by walking with the inner half of the boot sole thickened and a steel brace to maintain inversion. Ordinary flat-foot after reduction is treated in much the same way. The book closes with a few remarks on the prevention and treatment of contractions following amputations.

The illustrations are simple and good. On p. 46 there is an erroneous reference

to Figs. 31 & 32; no doubt Figs. 7 & 8 are intended. The work is primarily for general practitioners who are called upon, under present war conditions, to treat a large number of joint injuries; but it can be heartily commended to every hospital surgeon and resident, whether engaged in military or civil practice.

Lejars' Urgent Surgery. Third English Impression, translated from the seventh French Edition by WILLIAM S. DICKIE, F.R.C.S., Surgeon North Riding Infirmary, Middlesbrough, and ERNEST WARD, M.A., M.D., F.R.C.S. Vol. II. Pp. 588, with 10 plates and 601 illustrations. Super Roy. 8vo. Bristol: John Wright & Sons Ltd. 25s. net.

THE note of wide personal experience and of intense desire to help the reader is dominant in this book. The author is loyal to his own observations and experiences, and is free from that excessive respect for traditional methods which may sometimes be detected in the French school. He has realized, moreover, that the human mind is inaccessible to general statements unvitalized by particular instances, and his method of presenting a subject, for instance, 'urinary extravasation,' is to give at the very beginning a vivid relation of a particular case, drawn from the stores of his experience. A short sketch follows, presenting the possible variations of this typical clinical picture. Next come the orders for treatment, clear and definite as those of a drill-sergeant, expressed without the waste of a single word, and followed by an explanation of their rationale. The reader is told what to avoid, as well as what to do. In conclusion comes a paragraph on the rarer varieties of urinary extravasation. The essentials of the subject are compressed into three pages, and yet the effect is not that of a hard outline drawing, but of a truly vital picture.

These outstanding merits of the book may be the fruit of a natural gift for teaching, combined with that power of clear, concise, and finely-shaded expression which French writers owe to their incomparable language. More probably the author has laboriously forged his book from his experience, and its outstanding merits of matter and style are the result of careful and prolonged labour.

The translators, Messrs. W. S. Dickie and Ernest Ward, have done their work well, and the English is vigorous and idiomatic.

The present volume, completing the work, of which this is the third English impression, contains sections on the genito-urinary organs, the rectum and anus, the strangulated hernias, and the extremities. The section on amputations might with advantage be made fuller in the next edition.

The Origin and Nature of the Emotions. By GEO. W. CRILE, M.D., Professor of Surgery, School of Medicine, Western Reserve University. Large 8vo. Pp. 240, illustrated. London and Philadelphia: W. B. Saunders & Co. 13s. net.

"DOCTOR Crile is a very *imaginative* man." So remarked to me the greatest of English physiologists. The book under review justifies the description, and after all it is the men with scientific imagination who make our really great advances.

The book is a series of essays and addresses on the nature of fear, anger, pain, surgical shock, and the various medical diseases which produce exhaustion of what Crile calls the 'kinetic system.' Briefly, the theory is that the brain and adrenals and liver and thyroid work together to produce a response, usually muscular, such as fighting or running away, to harmful (nociceptive) stimuli. The response is due to the inherited experience of one's ancestors. If the individual cannot fight or run, the brain and glands are nevertheless exhausted; this is surgical shock, or fear or anger if consciousness remains unimpaired. Histological changes in the organs named can be demonstrated. The state of affairs is like that of a motor car stationary against a wall but with the engines running, consuming fuel and wearing out the gear. There is far more in the book than this, including some very interesting remarks on Graves's disease.

The illustrations are delightful; most of them are photographic studies of fear, anger, athletic exertion, or pleasure; also representations of the microscopical changes in the nerve-cells and glands. The phylogenetic evolution of the emotions, and their protective purpose in animals, are admirably worked out.

The book is most interesting and suggestive, and probably there is not another surgeon in the world who could have written it. Some of the theories are scarcely capable of proof, but there are some very substantial contributions to the vexed problem of the pathology of surgical shock. Prof. Crile seems to be laying less stress now than he originally did on the primary importance of exhaustion of the vasomotor centre; he finds changes in very much wider areas of the brain-cells. In this modification of his views he has undoubtedly brought us nearer to the truth.

The Operations of Surgery. By R. P. Rowlands, M.S. (Lond.), F.R.C.S., and Philip Turner, B.Sc., M.S. (Lond.), F.R.C.S, being the Sixth Edition of *Jacobson's Operations of Surgery*. In two volumes. Large 8vo. Pp. 1030 and 934, with 797 illustrations, 40 in colours. London: J. & A. Churchill. 50s. net.

This new issue of Mr. Jacobson's classic work reaches us just before we go to press. Its full consideration is therefore impossible in the present issue of the Journal, but we hope in our next number to do it the justice of a detailed review.

Pyelography (Pyelo-Ureterography). By Wm. F. Braasch, M.D., Mayo Clinic, Rochester, Minn., U.S.A. Large 8vo. Pp. 323, with 296 pyelograms. 1915. London and Philadelphia: W. B. Saunders Company. 21s. net.

Although it is now ten years since the outlines of the human renal pelvis and ureter were first demonstrated by means of pyelography, the method does not seem to have come prominently before the profession until the last two or three years.

Dr. Braasch has set down in this work his own experience of the subject, obtained in the Mayo Clinic. The fact that he has himself had experience of over a thousand cases shows that a large amount of work has recently been done, and Dr. Braasch has clearly emphasized the importance of the subject. The book is divided into ten chapters, each of which has a full and useful bibliography. The first deals with the history of pyelography, whilst the second is given over to the details of technique. It has been found that the best solution to be used is 10 per cent colloidal silver, and an accurate account is given of the method of its preparation. There appears to be no doubt that it is safer to introduce the solution by means of gravity rather than by the pressure syringe; with the latter many cases of necrosis of renal tissue have occurred, and other accidents. Gas pyelography does not seem to be satisfactory.

The chapter on the normal pelvis and calices is profusely illustrated by pyelograms. The healthy parts seem to vary so much, that considerable experience is necessary before pathological conditions can be diagnosed with any degree of accuracy. The chapter on renal stone is very good, and contains an accurate account of other shadows which may cause confusion in diagnosis. Included in this chapter is an account of the shadows thrown by gall-stones. Until recently, radiography of gall-stones has not met with much success, but Dr. Braasch reproduces several *x*-ray pictures showing the outline of gall-stones clearly, whilst other pictures are shown of the same cases when the pelvis is filled with collargol; the differentiation is at once manifest.

With careful attention to the author's directions as to the pressure of the injection and the fluid to be used, there seems to be little real danger attached to the filling of the renal pelvis and calices. The book is well printed, the skiagrams are clear, and the text is adequate. The work will prove to be of great practical value to those interested in the subject.